WRITING AND STYLE GUIDE FOR COLLEGE PAPERS AND ASSIGNMENTS

THE NEUROBIOLOGY OF WRITING

“**A must read (EVERY LAST WORD)**”
– author –

“Even fewer typos than the last edition”
– the proofreader –

“I can wait to read it”
– student –
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CHAPTER 1
FIELD NOTEBOOK GUIDELINE

Knowledge of the living world begins with scientific observations recorded in field notes. When biologists collect specimens to study, they keep field notes in which specimen names are recorded along with observations about the specimen, the collecting event, and the surrounding environment. Occasionally, drawings or photographs supplement written documentation. These are then used to draw conclusions, ask questions, or pose hypotheses. Along with this handout, Chapter 9 in A Short Guide to Writing About Biology by Pechenik (2016) has helpful hints in taking notes carefully and in detail.

Charles Darwin neglected to make careful field notes about the birds he collected among the Galapagos Islands. Not realizing at the time that the birds collected on the different islands represented different species of finch, all of which were new to science, Darwin didn’t even keep the specimens from different islands in separate packages. Fortunately, Captain FitzRoy and some of the crew members aboard the Beagle made their own bird collections during the voyage and did keep track of which birds came from which islands. Without their help, Darwin would never have been able to put the now-famous finch story together at all.

Observation is essential to field research. Scientific observation requires the use of senses to receive information about the specimens collected and the context in which the specimen is collected. Observations can be wrong, for example, when our senses fool us or when biases and assumptions cloud our perception. To aid their senses, scientists often employ instruments to obtain data about specimens like size, weight, sound or other characteristics. Instruments also aid scientists in capturing contextual information like time, temperature, altitude, coordinates, and other aspects describing when, how, and where specimens were obtained.

Essential Points of a Field Notebook

Your field notebook is your single most important field tool, as it constitutes the foundation for all conclusions, reports, and any other future work concerning the field area. Many researchers like to keep an annual field notebook, switching to a new one at the beginning of each year or field season. Others prefer a separate notebook for each expedition or trip. In keeping a field notebook, the essential points are:

1. Write it down now. Do not rely on your memory, and do not fool yourself into thinking that you will write it down later. You may be visiting many stops over several days, and the details will become confused or forgotten if you don’t write everything down while you are at each stop. Important discoveries are often made when researchers compare recent observations with those taken in the past.

2. Get everything you need. It often costs too much time or money to revisit an area, and sometimes it isn’t even physically possible to do so. Approach each stop as if
this is your only chance to be there, then act accordingly. Field notes also allow researchers to relocate particular sites many months or years later.

3. **Maintain your integrity.** The goal is to produce a document that you trust and that others can trust. Record your own observations and your own interpretations. If someone else (the instructor, for example) says something about the stop that you can’t directly verify, indicate that in your notes. Also, don’t erase or cover up your mistakes. Instead, draw a single line through them and keep going.

4. **Guard your notebook.** Keep it with you and keep it safe. Make copies (photocopies or back up disks) of its pages when field work is completed, and store them in a separate location from the originals. If your notebook becomes lost or damaged, a complete set of copies will be accepted in its place.

### Selecting a Notebook and Pen or Pencil

A field notebook must be permanently bound and have pages that come consecutively numbered, so that no pages may be added or removed without evidence. Proper notebooks are available in several sizes and styles of page ruling, but a handy solution is the “Rite in the Rain,” which is comparatively small and thin. This makes it conveniently portable, easy to use without a backboard, and assures that only a limited number of notes are kept in any one book in case of loss. “Rite in the Rain” and similar products are also water-resistant, unlike ordinary paper.

The pencil or pen must produce a clean, crisp, legible line all day. A wooden pencil is not adequate for this task, as it will soon become dull. You do not want to spend your valuable field time repeatedly sharpening your pencil. Acquire at least two mechanical pencils, preferably 0.5 mm hard lead, or at least two all-weather, fine-point, non-running pens. The pencils are better. If you choose to incorporate color into your field sketches, use a set of colored pencils, not pens or other markers.

### Standard Field Notebook

The standard field journal consists of three components:

1. **Journal** - narrative diary of daily observations, including locality information, weather and conditions and species lists;
2. **Species accounts** - running notes on individual observations of selected species. Both common and scientific names are given (where possible) followed by information of the species behavior, ecology, morphology, etc.
3. **Catalogue** - a systematic and sequential list of all captures and collections, including reference numbers (e.g., data collection during a caribou necropsy).
Journal

The journal should maximize information while employing economy of style. It is a complete account of your observations, and should be directly quotable. Include observational details that may seem obvious at the time (you never know when what you observe might be important, and just because you know something, doesn’t mean anyone else does). Remember the journal is a scientific report intended for use by others as well as yourself. It is NOT a diary, so avoid fantasy, comments on your love life, and trivia about how many eggs you had for breakfast.

When travelling, we have the opportunity to notice many ecological transitions or contrasts. It is especially useful to make clear note of these matters, since the information serves several useful functions:

1. It provides direct description of the ecological conditions on the ground where and when those observations are made. This can be valuable in later investigations of ecological trends over time.
2. The information will help you remember where you've been, and where photographs were taken (years after the memories of much of the trip have faded).

   a. **Location**: Observations of location range from general observations about the state and city to more specific observations like the name of a river, miles or paces from a landmark, or geographic coordinates (e.g., latitude and longitude).

   b. **Date and Time**: Biologists often observe the date and time that specimens were collected. Dates tell us about seasonal changes as well as placing events in a chronological order. Without a date, the journal entry loses a great deal of its usefulness. To avoid confusion with the date format (e.g., 1/4/10), use the day-month-year format and always spell out the month.

   c. **Weather**: Record the weather at dawn, dusk and midday, or when the weather changes significantly during the day. Essentials to include are temperature (°C), wind speed (in Beaufort Scale or km/hr), cloud cover, and precipitation. A cool, cloudy day may yield few observations and a moonlit night may yield fewer captures.

   d. **Habitats**: Record information about the plant community, forest type, and water sources near the site. These may be very important when comparing sites. Sketches or hand drawn maps may be a useful way to illustrate key elements of the habitat, locations of trap-lines, or den sites within the habitat.

   e. **Vegetation**: At times it will be useful to document the dominant plant species, and any fruiting/flowering species as these plants may serve as important food sites for wild mammals and birds.

   f. **Physical Characteristics**: Color is important because sometimes specimen colors, as on fish for example, fade after being collected. Biologists pay attention to measurements like length, height, or weight. Sound is also important to observe because that is how many animals communicate.

   g. **Species lists**: Record a list of all the bird and mammal species recorded each day or at each location. Always annotate the species lists with additional information such as how many individuals (estimated by order of
magnitude), whether the observation was a sign, sight, sound or capture record.

h. **Commentary:** Include any other observations of unusual activity, descriptions of your collecting methods, etc. in short, descriptive sentences. The more detail you can provide the better. Try and anticipate how you will use this data in the future and attempt to provide any information that may prove useful.

i. **Photos and Sketching:** Biologists often use photographs to remember what specimens and their surrounding environments look like. If an image is photographed, record the file name and include it with field notebook so others can avoid looking for it later. Many biologists also rely on sketches, even if they have photographs, because of the immediacy of sketching a drawing in a notebook. Sketching also allows biologists to depict certain concepts that are difficult with photographs.
**Species accounts**

Species accounts are organized so that all references to, and notes about, a particular species appear in one place. If you want to know everything you noted about a particular species you don’t have to wade through pages of daily journal to find the reference (each species will have a page to itself). Species accounts should be for detailed notes on species of interest.

Each species should have one or more pages to itself. The overall format is the same as for the journal. The species account is the place to write down a detailed description of the species and your observations of behaviour, ecology, phenology, morphology, reproduction and so on. You may also want to include the results of measurements and surveys. Drawings, maps and diagrams are appropriate. You do not have to be an artist to make effective use of drawing.

Maximize the information, and write with a clear purpose. Be as exact as you can, but avoid repeating too much information in the species account and daily journal. Give approximate numbers rather than descriptive terms like “some,” or “many.” Estimated numbers should be rounded off by zeros (e.g., 10, 40, 700, 1000).
CHAPTER 2
INNOVATIVE NOTE-TAKING METHODS
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Abstract

Many students are not aware that there are several methods for taking notes. Typically students try to write what they perceive to be the main ideas that are communicated during the lecture. Even if their current note-taking techniques are effective, they will still benefit by an awareness of other methods that can be adapted to different learning events. For example, by expanding their notes into diagrams and illustrations, students often learn to link key concepts together. This practical 'how-to' article reviews six different note-taking systems and explains their advantages and disadvantages. Along with this handout, Chapter 3 in A Short Guide to Writing About Biology by Pechenik (2016) has helpful hints.

Introduction

Effectively taking notes in class is one way for students to learn the material and receive a high mark. Note-taking can be said to fulfill several functions:

- First, it is a way of encoding information.
- Next, it is a way to accumulate and access the information.

One of the first studies on this topic by Crawford (1925) suggests a positive connection between student lecture-notes and students’ marks. An additional study by Carrier (1983) also seems to indicate that effective note-takers tend to do better on their courses, whilst a 1995 study by Robinson and Kiewra shows that some students benefit more from visually-based representations of ideas (similar to the mind-mapping method mentioned later) instead of text-based notes.

The author of this article, a university lecturer, allows his students to bring two index cards filled with whatever notes that they can fit on them to any of the exams. This approach has been popular with students and their participation has been close to 100%. The author explains to the students that by writing and re-writing the material, they will often commit it to long-term memory.

Much of the benefit of note-taking appears to come from the review necessary to condense the course material down to two index cards. Although this approach has worked well at the university level, there might be more resistance to it with teachers of younger students.

According to Newfields (2000), there are several common problems students face in taking notes. A brief description of the categories he describes include:
• **Writing too much** - Trying to record everything without considering the content.
• **Writing too little** - Some students simply do not take and notes, while others only jot down a few phrases.
• **Writing incorrect information** - Lack of accurate detail or a wrong arrangement of background information.
• **Not storing notes well** - Taking notes on loose scraps of paper instead of on notebooks. Notes that are not properly dated or arranged by subject, etc.
• **Not citing references** - Many students do not understand how to cite references correctly and have a hard time finding the sources later.
• **Not reviewing adequately** - The importance of review has already been mentioned. Instead of reviewing frantically just before an exam, students are likely to gain more value by reviewing once or twice a week throughout a semester.

Note-taking may be better understood through the Taxonomy of Educational Objectives, also known as Bloom’s Taxonomy (Bloom 1956), which provides a hierarchical guide to the process of learning:

• Bloom views **knowledge** at a low level of learning, as the observation and recall of information - such as the knowledge of dates, events, places and major ideas, and the mastery of subject matter.
Comprehension is seen as the next higher level of learning, this being the understanding of information, translating knowledge into new contexts, interpreting facts and comparing or contrasting.

Application is the use of this information, applying concepts and theories to new situations, and solving problems using acquired skills or knowledge.

Arguably, these aspects of learning can be enhanced by the note-taking process. For example, knowledge - as the observation and recall of information - can be increased through the organization and repetition of new material in the form of note-taking. Comprehension, as Bloom defines it, can be enhanced by the ability of the note-taker to translate the study material into organized notes. Arguably, application can be increased by the distillation of general concepts into keywords, as required by all six note-taking methods described below.

Note-Taking Systems for Further Review

This section briefly reviews six of the most widely-used note-taking systems, including the Cornell Method, the Outlining Method, the Mind Mapping Method, the Charting Method, Sentence Method, and the Note Card Method

1. **Cornell method**

The Cornell method, originally developed by Dr. Walter Paulk at Cornell University, provides a system and format for condensing and organizing notes without laborious recopying. This method requires the learner to create a 2½ inch left-hand margin. The rest of the page (6 inches for a standard page) is used for actually taking the notes. After writing the notes in the main space, the learner uses the left-hand column to label each concept, idea, or detail with a keyword or "cue."

Students can later review notes by covering the notes taken with a card, leaving only the left column visible. Students need to say each keyword or cue aloud and then say as much as they can of the hidden material. After saying as much as you can about the keyword, the hidden material is restored by moving the card and see if what is said matches with what is written. Arguably, 'If you can say it, you know it'.

**Advantages** - The Cornell Method provides an organized and systematic method for recording and reviewing notes. The pages provide an easy format for pulling out major concept and ideas. Note-taking is simple, efficient and saves time and effort. This may be the best method for taking notes that are meaningful and easy to review for many students.

**Disadvantages** - The only disadvantage would be if students did not make the effort to record keywords, or if the keywords they chose did not accurately reflect the material – or their learning styles and needs were not adequately reflected.
2. **Outlining method**

Indented outlining is usually helpful, except for some science classes such as physics or maths. With this method:

- The information which is most general begins at the left with each more specific group of facts indented with spaces to the right.
- The relationships between the different parts are carried out through indenting.
- No numbers, letters, or Roman numerals are needed.

Students listen and type notes in individual concepts or points. If they wish to take notes using digital means, one drawback involves the need to create one’s own indentation. In either case, students need to use an organized pattern. Broad points or main concepts should be positioned near the left margin. Sub-points need to be given proper emphasis based on space indentation. Each more specific point is indented to the right. Levels of importance will be indicated by distance away from the major point.

If taking handwritten notes, it is important to be careful to maintain relative spacing for indentions. Students need to use additional notation, such as Roman numerals or decimals if they are not confident in their ability to maintain spacing. Indention can be as simple as or as complex as labeling the indentations with Roman numerals or decimals. Done properly, additional labels or markings are not necessary, since the space relationships will indicate the major/minor points.

**Advantages** - A well-organized system if used correctly. Outlining records content as well as relationships can take place. Outlining also reduces editing. Notes are easy to review by turning main points into questions.

**Disadvantages** - This method requires more thought in class for accurate organization. This system may not show relationships by sequence when needed. It does not lend itself to diversity of a review attach for maximum learning and question application. This system cannot be used if the lecture is too fast. It also seems to place more importance on large concepts used for groupings than the supporting details, and arguably in some cases, supporting details can be more important than the subject category or concept under which they are found.

**When to Use** - The outline format can be used if the lecture is presented in outline organization. This may be either deductive (regular outline) or inductive (reverse outline where minor points start building to a major point). Use this format when there is enough time in the lecture to think about and make organization decisions when they are needed. This format can be most effective when your note-taking skills are super sharp and you can handle the outlining regardless of the note-taking situation.

3. **Mapping method**
Maps, which are often called “mind maps,” are created using the Mapping Method. Mapping is a method that uses comprehension/concentration skills to create notes that relate/link each fact or idea to other facts or ideas. Mapping creates a graphic representation of a lecture content. The Mapping Method maximizes active participation, affords immediate knowledge as to its understanding, and emphasizes critical thinking.

The Mapping Method is easiest to execute using digital ink on a Tablet PC or other ink-enabled computer. To use:

- Select a blank note page for your notes.
- Use your digital pen to record key concepts and draw lines to relate these concepts to each other. You can put circles around the most important topics and squares or other shapes around supporting concepts.
- You may decide not to imply any importance initially and simply use the number of relationships to determine the importance of some of the key concepts.

**Advantages** - This format helps you to visually track the lecture regardless of conditions. Little thinking is needed and relationships can easily be seen. It is also easy to edit notes by adding numbers, marks and colour-coding. 'Review' requires the restructuring of thought processes which will force students to check understanding. Review is simple by covering lines and clusters to recall relationships. Main points can be written on flash or note cards and pieced together into a table or larger structure at a later date.

**Disadvantages** - Unique points are not always clear in lectures. Students may easily miss some related concepts or not hear changes in content from major points to facts.

**When to Use** - Use the Mapping Method when the lecture content is heavy and well-organized. This method may also be used effectively when listening to a guest lecturer or whenever one cannot anticipate how a lecture is going to be organized or presented.

4. **Charting method**

If the lecture format is distinct (such as chronological), students may set up their paper by drawing columns and labeling appropriate headings in a table. Determine the categories to be covered in the lecture before the start of the lecture or based on the tutor’s initial notes. Paper can be set up by creating columns headed by these categories. As students listen to the lecture, they record information (words, phrases, main ideas, etc.) into the appropriate category.
**Advantages** - The Charting Method helps track conversation and dialogues where students may normally be confused and lose relevant content. This method reduces the amount of writing necessary and provides easy review mechanism for both memorization of facts and study of comparisons and relationships.

**Disadvantages** - Students need to learn how to use the system and be able to identify appropriate categories for the lecture. They must also have the skill to hear and understand each point in a lecture, so not to miss any important information for the chart.

**When to Use** - This method works best when the information presented is focused on both facts and relationships. It is also desirable when the content presented is heavy or presented quickly. The Charting Method can also be used to reduce the amount of time spent editing and reviewing notes at test time. Charting can also be used to create an overview of the whole course on one big paper sequence.

5. **Sentence method**

This method requires students to write every new thought, fact or topic on a separate line, numbering each sentence as they progress. It may be helpful to use abbreviations or shorthand during the lecture and then clean up and rearrange notes at the end of class.

**Advantages** - This method is slightly more organized than writing full paragraphs and enables capture all information from a lecture. There is no extensive thinking or preparation to organize notes.

**Disadvantages** - The notes will not distinguish between major and minor points from the numbered sequence. These notes are typically difficult to edit without rewriting the clustering points which are related. The notes are more difficult to review unless they have been edited to create relationships with other points.

**When to Use** - Use when a lecture is fairly organized but the information comes too fast to use other methods. Also use when one can distinguish between points in a lecture but one is unsure how the points relate to each other. This is also useful if the tutor presents information as lists of points, but when groupings are not always clear. Shorthand and abbreviations are useful when using this method.

6. **Note-card method**

This method is similar to the Cornell one in some respects. However, each unique concept or element is captured on a unique note-card. Each quote, concept, outline or summary is included on a separate note-card. These cards can then be reviewed individually. It is particularly useful to capture each topic, concept, quote or related group of points on a unique note-card, which can be done by inserting a new card for each topic. After taking notes, students can review their cards by hiding the notes and reading the subject or topic
of each card aloud, then trying to recite the information included on the card. Cards can be used as ‘flash-cards’ for review. This is especially useful when studying with others or reviewing as a group.

**Advantages** - To capture “bite sized” pieces of information and one is forced to create organization to conserve space and keep related content on the same cards. This is an excellent method for capturing information for later review.

**Disadvantages** - The main disadvantage of note-cards is that course content does not always fit neatly onto them. Students may need to use multiple cards to capture all related information for the same topic. Paper note-cards often lead to increased use of paper and increase the risk of losing notes, since they are distributed across so many pieces of paper - and note cards are typically unbound.

**Six Steps to Effective Note-Taking:**

- **Record**: The practice of taking notes or capturing course content.
- **Reduce (or question)**: Reviewing notes to reduce them into related keywords, phrases or questions.
- **Recite**: Restate aloud and in your own words the content of your notes.
- **Reflect**: Ponder what you have learned for new applications and deeper understanding.
- **Review**: Review your notes often and regularly through recitation (not re-reading) to ensure understanding.
- **Recapitulate**: Summarize your learning by each page or by lecture to ensure knowledge and understanding of key points.

**References**


In any assignment it is absolutely necessary to give credit to others’ ideas. Any ideas borrowed from another source must be referenced.

- Cutting and pasting ideas from the internet is PLAGIARISM.
- Cutting and pasting work from the internet AND citing the work is PLAGIARISM.

**Ideas must be in your own words and referenced.** In one paragraph of paraphrased ideas you often have several different citations depending how many sources you used in that paragraph. If in doubt, please refer to the helpful hints outlined in *A Short Guide to Writing About Biology* by Pechenik (2012).

**Paraphrasing Effectively**

When you borrow someone else’s ideas for your assignment you must put these ideas into your OWN WORDS. Here, we will be using the format observed in *Ecology*. Several examples are provided below from different sources.

- Read the passage several times until you understand it.
- Set the work aside to avoid copying.
- Rewrite the passage in your own words. Avoid the use of quotes.
- Record the bibliographic information with your paraphrased version of the original.

For example, look at the following two passages and note that Student A is merely describing the literature and Student B takes a more analytical and evaluative approach, by comparing and contrasting. You can also see that this evaluative approach is well signalled by linguistic markers indicating logical connections (words such as “however,” “moreover”) and phrases such as “substantiates the claim that,” which indicate supporting evidence and Student B’s ability to synthesize knowledge.
**Student A**

Smith (2000) concludes that personal privacy in their living quarters is the most important factor in nursing home residents’ perception of their autonomy. He suggests that the physical environment in the more public spaces of the building did not have much impact on their perceptions. Neither the layout of the building, nor the activities available seem to make much difference.

Jones and Johnstone (2001) make the claim that the need to control one’s environment is a fundamental need of life, and suggest that the approach of most institutions, which is to provide total care, may be as bad as no care at all. If people have no choices or think that they have none, they become depressed.

**Student B**

After studying residents and staff from two intermediate care facilities in Calgary, Alberta, Smith (2000) came to the conclusion that except for the amount of personal privacy available to residents, the physical environment of these institutions had minimal if any effect on their perceptions of control (autonomy). However, French (1998) and Haroon (2000) found that availability of private areas is not the only aspect of the physical environment that determines residents’ autonomy. Haroon interviewed 115 residents from 32 different nursing homes known to have different levels of autonomy (2000). It was found that physical structures, such as standardized furniture, heating that could not be individually regulated, and no possession of a house key for residents limited their feelings of independence. Moreover, Hope (2002), who interviewed 225 residents from various nursing homes, substantiates the claim that characteristics of the institutional environment such as the extent of resources in the facility, as well as its location, are features which residents have indicated as being of great importance to their independence.

**Citing Published Sources in Text**

In most cases, reference citations parenthetically at the end of a sentence. For example, *Mallard brood survival was higher in the wettest years (Rotella 1992).* Cite published literature by author and year - e.g., Jones (1980), Jones and White (1981). Use et al. for publications with ≥3 authors - e.g., (Jones et al. 1982). Do not separate the author and date by a comma, but use a comma to separate a series of citations.

Use chronological order for citations in a series - e.g., (Jones 1980, Hanson 1986). If citations in a series have >1 reference for the same author(s) in the same year, designate the years alphabetically and separate citations with semicolons - e.g., (Jones 1980a, b; Hanson 1981; White 1985, 1986). If citations have >1 reference for the same author in different years, designate the years chronologically after the author’s name (e.g., Andrews
For citations in a series with the same year, use alphabetical order within chronological order - e.g., (Brown 1991, Monda 1991, Rotella 1991, Allen 1995). Do not give >5 citations in the text to reference a specific issue or scientific finding.

Citing Unpublished Sources in Text

If references are not easily available or are not widely distributed, cite them in the text only (i.e., citation does not appear in the reference list at the back of the paper). Unpublished sources include reports that are not published or widely distributed, manuscripts that have not yet been accepted for publication, and personal communications and observations. Avoid overusing unpublished information, as these citations are not as credible as published literature and will make your text cumbersome. Cite unpublished references in the text as follows:

- Personal communications: (J.G. Jones, personal communication);
- Unpublished report: (D.F. Timm and E.J. Jones, unpublished report);

Citing Equipment and Statistical Software

For field equipment, note the manufacturer name and location parenthetically the first time you mention the equipment in the text (e.g., Interface, Missoula, MT). Citations should also include the manufacturer information (manufacturer, city, and state [or country if not USA] of manufacture) immediately following the first use of the statistical product name (e.g., SAS Institute, Inc., Cary, NC; Environmental Systems Research Institute, Inc., Redlands, CA). Only include software in Literature Cited if you are referencing the software manual or other publication describing the function of the program - e.g., Program MARK (White and Burnham 1999), otherwise simply cite the software within the text.

Citing Images

When an image is included in a paper, cite it similar to the format observed in a book or a newspaper article. Under copyright law you are allowed to use images for educational purposes. Most often, images are found online so use the image title or a general description in your text followed by the reference citation parenthetically at the end of a sentence. In the text, refer to figures by their number (i.e., Figure 1 or Figure 2). Do not refer to figures as “the figure below” or “the figure above.” Most importantly, provide a brief description of the image. The caption should serve as both a title and explanation.
**Example:** The nurse log is a common feature of Pacific Coast temperate rainforest ecosystems (Figure 1), where the damp environment and rich nutrients of decaying trees provide ideal conditions for growing coniferous seedlings.

![Nurse log in Esowista Indian Reserve 3, British Columbia (Sayer 2007).](image)

Figure 1. Nurse log in Esowista Indian Reserve 3, British Columbia (Sayer 2007).
CHAPTER 4
LISTING REFERENCES

Your reference list should appear at the end of your paper. It provides the information necessary for a reader to locate and retrieve any source you cite in the body of the paper. This presentation enables the interested reader to locate and examine the basis for factual statements made in your paper. It occasionally happens that a reference is used incorrectly; your interpretation or recollection of what was said in a textbook, lecture, or journal article may be wrong. By giving the source of your information, the reader can more easily recognize such errors. Each source you cite in the paper must appear in your reference list; likewise, each entry in the reference list must be cited in your text.

Your references should begin on a new page separate from the text of the essay. Label this page “Literature Cited” in bold centered at the top of the page (do NOT underline or use quotation marks for the title). All text should be single-spaced unlike the rest of your essay, which is double-spaced.

Basic Rules

1. Each listing must include the names of all authors, the year of publication, and the full title of the paper, article, or book.
2. Authors’ names are inverted (last name first); initials are used for first and middle names.
   a. Include the names of all authors, even though the names of only 1 or at most 2 authors (e.g., Croll and Voronezhskaya 1996; Woodin et al. 1995) are cited in the text of the paper.
   b. Reference list entries should be alphabetized by the last name of the first author of each work.
   c. For multiple articles by the same author, or authors listed in the same order, list the entries in chronological order, from earliest to most recent.
3. Latin names (typically scientific names) are italicized.
4. When referring to books, chapters, articles, or web pages, capitalize only the first letter of the first word of a title, the first word after a colon or a dash in the title, and proper nouns (e.g., Canada).
5. Journal names should be spelled out, with the first letter of each word capitalized other than the, or, or and. If the journal name starts with “the” (e.g., The Auk), remove “the” from its name (e.g., Auk).
Citing Format for Different References

Unfortunately, formats differ from journal to journal. The most important rule in preparing the Literature Cited section is to provide all the information required and to be consistent in the manner in which you present it. Here, we will be using the format observed in Ecology. Several examples are provided below from different sources.

**Book**


**Book (>1 edition)**


**Book (>1 publisher)**


**Book (>1 volume)**


**Book (editor as author)**


**Book (reprint)**

Leopold, A. 1933. Game management. 1946, Reprint. Charles Scribner’s Sons, New York, New York, USA.
**Book (chapter in a book)**


**Court cases**

Cite complete title and year of case in text only.

**Foreign language publication**

Angulo, E. 2003. Factores que afectan a la distribución y abundancia del conejo en Andalucía. Dissertation, Complutense University, Madrid, Spain. [In Spanish.]

**Government publication**


**Government publication (part of a numbered series)**


**Government publication (agency as author)**


**Images (online)**


**Journals**


**Journals (in press)**


**Lab manual**

Dietz, H.G.S. 2012. Biology 220 laboratory manual: How can we use chemicals to control microbial growth? University of Regina, Regina, SK.

**Newspaper, newsletter, and magazine articles**


**Software package**


**Symposia and proceedings (complete volume)**


**Symposia and proceedings (individual article)**


**Symposia and proceedings (part of a numbered series)**


**Symposia and proceedings (complete volume - not part of a numbered series)**

Symposia and proceedings (individual article - not part of a numbered series)

Theses and dissertations

Web citation (professional site)

Web citation (article in an ejournal)

Web citation (government publication)
CHAPTER 5
A GUIDELINE FOR WRITING OUTLINES

What is an Outline?

An outline is a formal system used to think about and organize your paper. For example, you can use it to see whether your ideas connect to each other, what order of ideas works best, or whether you have sufficient evidence to support each of your points. Outlines can be useful for any paper to help you see the overall picture.

There are two kinds of outlines: the topic outline and the sentence outline.

- The topic outline consists of short phrases. It is particularly useful when you are dealing with a number of different issues that could be arranged in a variety of ways in your paper.
- The sentence outline is done in full sentences. It is normally used when your paper focuses on complex details. The sentence outline is especially useful for this kind of paper because sentences themselves have many of the details in them. A sentence outline also allows you to include those details in the sentences instead of having to create an outline of many short phrases that goes on page after page.

Both topic and sentence outlines follow rigid formats, using Roman and Arabic numerals along with capital and small letters of the alphabet. This helps both you and anyone who reads your outline to follow your organization easily. This is the kind of outline most commonly used for classroom papers and speeches (see the example at the end of this paper). There is no rule for which type of outline is best.

Choose the one that you think works best for your paper.
Make the Outline

- **Identify the topic.** The topic of your paper is important. Try to sum up the point of your paper in one sentence or phrase. This will help your paper stay focused on the main point.
- **Identify the main categories.** What main points will you cover? The introduction usually introduces all of your main points, then the rest of paper can be spent developing those points.
- **Create the first category.** What is the first point you want to cover? If the paper centers around a complicated term, a definition is often a good place to start. For a paper about a particular theory, giving the general background on the theory can be a good place to begin.
- **Create subcategories.** After you have the main point, create points under it that provide support for the main point. The number of categories that you use depends on the amount of information that you are going to cover; there is no right or wrong number to use.

By convention, each category consists of a minimum of two entries. If your first category is Roman numeral I, your outline must also have a category labeled Roman numeral II; if you have a capital letter A under category I, you must also have a capital letter B. Whether you then go on to have capital letters C, D, E, etc., is up to you, depending on the amount of material you are going to cover.

You are required to have only two of each numbered or lettered category.

Keep Your Outline Flexible

Although the format of an outline is rigid, it shouldn't make you inflexible about how to write your paper. Often when you start writing, especially about a subject that you don't know well, the paper takes new directions. If your paper changes direction, or you add new sections, then feel free to change the outline - just as you would make corrections on a crude map as you become more familiar with the terrain you are exploring. Major reorganizations are not uncommon; your outline will help you stay organized and focused.

However, when your paper diverges from your outline, it can also mean that you have lost your focus, and hence the structure of your paper. How do you know whether to change the paper to fit the outline or change the outline to fit the paper? A good way to check yourself is to use the paper to recreate the outline. This is extremely useful for checking the organization of the paper. If the resulting outline says what you want it to say in an order that is easy to follow, the organization of your paper has been successful. If you discover that it's difficult to create an outline from what you have written, then you need to revise the paper. Your outline can help you with this, because the problems in the outline will show you where the paper has become disorganized.
**Topic Outline**

**Thesis:** The decisions I have to make in choosing college courses, depend on larger questions I am beginning to ask myself about my life’s work.

I. Two decisions described  
   A. Art history or chemistry  
      i. Professional considerations  
      ii. Personal considerations  
   B. A third year of French?  
      i. Practical advantages of knowing a foreign language  
      ii. Intellectual advantages  
      iii. The issue of necessity

II. Definition of the problem  
   A. Decisions about occupation  
   B. Decisions about a kind of life to lead

III. Temporary resolution of the problem  
   A. To hold open a professional possibility: chemistry  
   B. To take advantage of cultural gains already made: French

**Sentence Outline**

**Thesis:** The decisions I have to make in choosing college courses, depend on larger questions I am beginning to ask myself about my life’s work.

I. I have two decisions to make with respect to choosing college courses in the immediate future.  
   A. One is whether to elect a course in art history or in chemistry.  
      i. One time in my life, I planned to be a chemical engineer professionally.  
      ii. On the other hand, I enjoy art and plan to travel and see more of it.  
   B. The second decision is whether to continue a third year of French beyond the basic college requirement.  
      i. French might be useful both in engineering and travel.  
      ii. Furthermore, I am eager to read good books which are written in French.  
      iii. How necessary are these considerations in the light of other courses I might take instead?

II. My problem can be put in the form of a dilemma involving larger questions about my whole future.  
   A. On the one hand I want to hold a highly-trained position in a lucrative profession.  
   B. On the other hand I want to lead a certain kind of life, with capacities for values not connected with the making of money.

III. I will have to make a decision balancing the conflicting needs I have described.  
   A. I will hold open the professional possibilities by electing chemistry.  
   B. I will improve and solidify what cultural proficiency in another language I have already gained, by electing French.
Instructions for Students Prior to Submission

In most biology courses, you will be asked to write essays. All text must be double-spaced with 1” margins on all sides, use font size 12 (e.g., Times New Roman), well-written and free from spelling and grammatical errors, and pages must be numbered in the footer with your name and arranged in the correct sequence. A cover page must accompany the essay with an appropriate title that tells what the essay is about. Under it should be your “professional address,” which in this case is the specific course in which you are enrolled, and name of the instructor. Do not forget to include your name and date.

Title

A title should be informative, specific, and concise. Since you are not writing a murder mystery, it is alright to tell the “ending” in the title. It is often this information that helps a reader decide if the paper is something he/she wants to read. Here are few examples that illustrate this point:

**Really bad title:** Lab 2 - Plant phenotypes

This tells the reader nothing except that the second lab of the semester involved looking at plant phenotypes. Although it may distinguish this project from others in this course, it would not help someone outside of class understand what the paper is about.

**Better but not very good title:** Growth and phenotypic variation in Solidago gigantea

This gives specific information about the organism and type of measurement, but still does not inform the reader about the problem being investigated. Why do you want to measure variation in growth of Solidago gigantea?

**Good title:** Solidago gigantea growth shows lower heritability than morphological characters

The title indicates that the objective was to compare levels of heritability in different characters of Solidago gigantea, including the results.

Use of headings

For longer papers, it may be helpful to break the text into sections to avoid unnecessarily strained transition sentences. Headings can help by keeping the reader informed about
where they are in the paper (i.e., headings are like directions or signposts that orient the reader). They may also act as organizing structures for the writer. However, you can always start with headings that you later remove. Doing so may help you stay on topic and provides a more clear structure for the paper in the initial rough draft.

Formatting of headings should remain simple. Don’t introduce new fonts or other jazzy tricks. **Headings can be bolded or italicized** (be consistent, and there is no need to do both). There is no hard and fast rule regarding **left justified or centered**, but whatever you do, it should be consistent. Usually, papers require only one level of headings. These headings are generally set apart from the previous paragraph using an extra line (or lines, depending on the spacing of the paper overall). The following paragraph should stay in the same spacing pattern as the overall paper (see example).

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**What is an Essay?**

Essays can be a rewarding and challenging type of writing and are often assigned either to be done in class, which requires previous planning and practice (and a bit of creativity) on the part of the student, or as homework, which likewise demands a certain amount of preparation. Many poorly crafted essays have been produced on account of a lack of preparation and confidence. Essays are shorter pieces of writing that often require the
student to hone a number of skills such as close reading, analysis, comparison and contrast, persuasion, conciseness, clarity, and exposition. As is evidenced by this list of attributes, there is much to be gained by the student who strives to succeed at essay writing. Along with this handout, Chapter 7 in *A Short Guide to Writing About Biology* by Pechenik (2016) provides helpful hints to writing essays.

### Getting Down to Writing

The most experienced writer can find a blank page daunting. The trick is to just start writing. It doesn’t matter where you begin as long as what you write ends up in the right place in the end. Just write, don’t worry about spelling and style. Get your first thoughts down on paper. Once you have done this you can sort out your ideas using your initial plan. Don’t use obscure or complex words or phrases for the sake of it, but avoid slang and abbreviations. Generally, stick to shorter sentences, but remember to vary these with some longer ones occasionally.

If you compose on a computer you can “cut and paste,” moving paragraphs around to their final place in the essay. If you prefer pen and paper, leave a line or two between ideas so you can physically “cut and paste.” Get the scissors and sticky tape out and cut your essay up. Sitting on the floor with your work spread out around you can be useful at this stage. As long as you end up with a beginning (the introduction), a middle (the body of the essay), and an end (the conclusion), you will not go too far wrong.
Introduction

The introduction explains the focus and establishes the importance of the subject. It discusses what kind of work has been done on the topic and identifies any controversies within the field or any recent research which has raised questions about earlier assumptions. It may provide background or history. It concludes with a purpose or research statement. Remember you are not writing a book, so you need to select a few main arguments to support your answer to the question. When you use source material, you must make a reference to it in your text and give the full details in your literature cited. This section is approximately 10% of the length of your essay.

Body

Often divided by headings, the body summarizes and evaluates the current state of knowledge in the field. This is where you will need to think about the structure of your essay and make sure you follow a clear path through to your conclusion. This section is where most writers go wrong, but if you plan carefully you should have a direction for your essay before you start writing.

Conclusion

The conclusion summarizes all the evidence presented and shows its significance. If the essay is an introduction to your own research, it highlights gaps and indicates how previous research leads to your own research project and chosen methodology. If the essay is a stand-alone assignment for a course, it should suggest any practical applications of the research as well as the implications and possibilities for future research. This section is approximately 10-15% of the length of your essay.
Editing and Proofreading

A review is essential even if it may not result in much rewriting. You might even get a friend to listen while you read aloud - this can help a lot if you're worried about clumsy sentence structure, punctuation or illogical ordering of your ideas. If you have no willing friend, read to a tape recorder and play it back to yourself. Try to be objective and as critical as possible. Make sure you spell check your work and refer to a dictionary for words that your computer doesn’t recognize as mistakes. The college has available free to use Grammarly (www.grammarly.com/edu) to review your manuscript.

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Checklist of Key Features of an Essay

☐ The title is informative.
☐ The opening paragraph indicates the specific direction that the paper will take, and it leads to a clear thesis statement that will drive the rest of the paper.
☐ All statements of fact and opinion are supported by references or examples.
☐ Research papers and other references are discussed in relation to one another, rather than in isolation.
☐ How particular results support particular hypotheses or lead to specific questions is indicated.
☐ No new information is presented in the final paragraph (conclusion).
CHAPTER 7
A GUIDELINE FOR WRITING FORMAL LAB REPORTS

Instructions for Students Prior to Submission

In most biology courses, you will be asked to write scientific lab reports that conform to science journal articles. Along with this handout, Chapter 9 in *A Short Guide to Writing About Biology* by Pechenik (2016) has helpful hints. All text must be double-spaced with 1” margins on all sides, use font size 12 (e.g., Times New Roman), well-written and free from spelling and grammatical errors, and pages must be numbered in the footer with your name and arranged in the correct sequence. A cover page must accompany the lab report with an **appropriate title**. Under it should be your “professional address,” which in this case is the **specific course** in which you are enrolled, and **name of the instructor**. Do not forget to include your **name** and **date**.

Use the **PAST TENSE** when describing your experiment and the results, and the **PRESENT TENSE** when discussing general properties of organisms. Never start a sentence with a numeral (“2” is a numeral; “Two” is not). Biological editors recommend using the active voice (rather than the passive) in scientific reports. For example, “The plants were measured . . .” should be rewritten as, “We measured the plants . . .” And finally, never apologize for lack of data – assume that you have done the best job possible!

The following describes how your paper should be organized. However, this doesn’t mean that you should **WRITE** the paper in this order! We suggest writing the report in the following order: (1) Methods, (2) Results, (3) Discussion, (4) Introduction, (5) Abstract, (6) Title, and (7) Literature Cited. The report will be appraised on the basis of conciseness, organization, writing quality, and interpretation and discussion of the results. In each section below are listed some “fatal flaws.”

**Abstract**

The abstract is a condensed version of the entire paper. It allows a reader to quickly understand the purpose, methods, results and significance of your research without
reading the entire paper. Abstracts of papers published in scholarly journals are useful to you when you are conducting library research, because you can quickly determine whether the research report will be relevant to your topic. The material in the abstract is written in the same order as that within the paper, and has the same emphasis. An effective abstract should include a sentence or two summarizing the highlights from each of the sections: introduction (including purpose), methods, results, and discussion. To reflect the content of the paper accurately, the abstract should be written after the final draft of your paper is complete, although it is placed at the beginning of the paper.

**Introduction**

The introduction should briefly explain why the research was done, relating this research to other relevant work and giving the reasons for choosing the hypothesis to be tested. A good way to organize the introduction is to begin with the general and proceed to the specific. Assume that the reader is at least moderately familiar with the general subject of the paper. However, unless you are studying a model organism (e.g., *Drosophila*, *E. coli*, etc.), it is important to describe enough aspects of its natural history that the reader can appreciate why it was chosen for the study. On the first mention of your organism, include its Latin binomial (scientific name) in *italics*. End with a clear but brief summary of the scope and purpose. If your lab report includes the test of a hypothesis, state it in the last paragraph.

A good introduction will mention the major issues that will be considered in the Discussion section, and that's why I suggest writing it after finishing the other sections. **Do not start the paper with the phrase:** "The goal of this experiment was . . ." This is not a general statement about the subject.

**Methods**

This section should carefully explain how the research was done. Organize the sections logically, using subheadings if there are more than several paragraphs. Typical subheadings under the **METHODS** may include *Study Area* and *Statistical Analyses*. Include all materials used, the exact conditions employed, and how you gathered the data. For field studies, begin with a description of the study area and time of study. You may cite the lab manual (or another source) for a common technique. Here’s an example:

**Bad:** “We measured growth rates and wrote down the data.”

How did you measure growth rates? You don’t need to tell the reader that you recorded the data or entered it into the computer.

**Good:** “We estimated yeast density following Brown and Eckhart (1997).”
If you develop your own technique, you should explain it in sufficient detail that another person could replicate your work. Tell exactly what materials you used (composition of solutions, media, etc.) and describe the procedures precisely. Commonly used statistical tests generally need no explanation. Do not present your methods as a list. Write in complete sentences and organized paragraphs.

Results

The results section should summarize, but not interpret, the results obtained. One good way to approach the writing of this section is to develop a set of questions about the data you gathered. Don’t use any questions that begin with “Why” – these necessarily involve interpretation, so they should be addressed in the Discussion section. Write the Results section by answering each of these questions in a logical order. Refer to figures and tables as you describe the results.

Figures and tables frequently will help the reader to understand more easily than a written description. They should not duplicate text, and text should only tell the reader the major points to be noted on the graphs or tables (i.e., should tell the reader what you think is particularly important about the data presented). Obviously the same data should not be presented in two different forms, so decide which form helps tell the reader what you want them to know. Graphs of any kind, as well as other pictorial materials, are referred to as Figures in the text, and are numbered. Tables are called Tables in the text, and are numbered separately from figures. They may either follow the first reference to them in the text, or all may be collected at the end of the paper. All figures/tables must be “called out” or referred to before they are explained in the text.

Bad example: “The results are shown in Graph 1.”

This is not a summary of the results, and the graphs should be referred to as “Figures.”

Another bad example: “Growth rates under low fertilizer had an average of 3.2 ± 1.4 g (SE), and growth rates under high fertilizer treatment had an average of 6.5 ± 1.0 g (Figure 1). Since the intervals do not overlap, they are different at the 0.05 level.”

The text here repeats specific information that is shown in the figure. Because the figure conveys this information more efficiently it’s not necessary to repeat it in the text. It is also not necessary to explain why non-overlapping standard errors (SE) indicate a significant difference since this is a commonly used statistical test.

Good example: “We found that higher levels of fertilizer resulted in significantly larger growth rates (Figure 1).”
Graphs

- Use a graph to illustrate a relationship or pattern in your data.
- Be sure that the type of graph you choose is appropriate for the type of data you wish to display. What assumptions are you making by using a particular type of graph (e.g., a line graph with the points connected indicates that the variables are continuous over the range displayed).
- By convention, the independent variable (the one you manipulated) is on the X-axis and the dependent variable (the result of the manipulation) is on the Y-axis.
- The axes of a graph must have clear, concise labels. If there is more than one line or bar on the graph, each must be clearly identified.
- All figures must have clear and specific legends. A legend is written as an incomplete sentence with only the first word capitalized and should begin with “Figure 1. The . . .” If required for clarity, you may include several more sentences. It should be placed above or below the figure.

Tables

- Tables are used to present matrices of data. If it is important to show a pattern or trend, use a graph instead of a table.
- Do not present raw data and expect the reader to do the arithmetic before he/she can understand the contents of a table. Printouts of EXCEL worksheets with raw data are NOT acceptable tables!
- Try to avoid large tables – no one will read through them. The information can be presented better in several smaller tables.
- All tables must have legends that explain their contents sufficiently that they can stand alone (much like figures). It is sometimes appropriate to have footnotes for a table.

Imagine that you have done an experiment that compares growth rates of *Brassica* under two different fertilizer treatments.

- The following is an example of a BAD GRAPH:
- Here’s a much better version of this graph:

**Discussion**
The discussion should interpret and explain the meaning of your results and usually proceeds from the specific to the general. Begin with a summary of your results in a sentence or two. Remind the reader of important trends. Then relate your results to your own initial hypothesis, arguing for a particular interpretation of your data. Don’t forget that “negative” results can be important too because they may suggest that your hypothesis was incorrect (it is just possible that you did everything perfect). Relate your results as well to other papers or published hypotheses when appropriate. Organization is especially important since you are drawing on, interpreting, and relating information from several sources. Be selective as you write: each word and phrase should convey useful information.

The discussion should end with a summary - the “take home lesson” that you want your reader to remember about your work. It may also raise further questions for study. Do not end the Discussion with the phrase, “but of course more work needs to be done.” Please let me know what kind of work would be most informative and why?

Literature Cited

The literature cited lists only the papers or other publications that were directly referred to in the lab report – they are not a bibliography (i.e., a list of all materials used to get background knowledge on a subject). Remember that ALL information within the report that is not your original work or ideas should be referenced. References should be cited in one of two ways in the text:

Mention the authors’ names as part of your sentence followed by the year of publication in parentheses. For example, Brown and Wilson (1992) performed a set of experiments demonstrating variability in host specialization . . .

Place authors’ names and the year of publication in parentheses following ideas or results from the study. For example, A phylogenetic tree of the yucca moth family indicates the important role of host-plant association in the evolution of this group (Brown et al. 1994).

Appendix (Optional)

In a laboratory report, appendices often are included, but are optional in journals. One type of appendix that appears in laboratory reports presents information that is too detailed to be placed into the report’s text. Extensive calculations used to arrive at values reported in the Results section should be included here rather than in the main text. Refer the reader here by writing, “A detailed description of the calculations can be found in the Appendix.”
Checklist of Key Features of a Lab Report

Title page
☐ Title of your report, course number, date, and your name

Abstract
☐ A précis: report the essentials of your study and omit extraneous details

Introduction
☐ Overview of the pertinent literature
☐ Identification of the organism(s) and/or ecosystem
☐ Statement of the hypothesis or problem

Methods
☐ Description of the study site and location
☐ Summary of methods to permit replication of the study

Results
☐ Report of your raw observations
☐ Mention each Table or Figure parenthetically to guide the reader
☐ Tables:
  • Heading at top
  • Numbered in order of mention in Results
  • Columns labelled, units indicated
☐ Figures:
  • Include graphs, drawings, and maps
  • Caption at bottom
  • Axes labelled with units, symbols identified (if >1 used)

Discussion
☐ Interpretation of results in terms of hypothesis
☐ Comparison with the pertinent literature
☐ Consideration of assumptions, comments on nature and cause of anomalous data

Literature Cited
☐ 1-to-1 correspondence between references in text of paper and in this section
☐ Adherence to correct format

Appendix
☐ Table(s) of raw data and sample calculation(s), if applicable
GRADING RUBRIC

PROBLEM 1 (TOTAL POINTS: 10)

GOT CORRECT ANSWER: 10 PTS
YAY!

USED CORRECT FORMULA, BUT MADE MATH ERROR: 8 PTS
TSK TSK...

SORT OF KNEW WHAT TO DO, BUT USED WRONG FORMULA: 6 PTS.
SO CLOSE!

OBVIOUSLY HAD NO CLUE BUT GAVE IT THE OLD COLLEGE TRY: 2 PTS
NICE TRY.

LEFT IT BLANK: 0 PTS
DO YOU EVEN CARE?

COMPLETE NONSENSE: -10 PTS
ARE YOU EVEN IN THE CLASS??

FORGOT TO PUT THEIR NAME ON THE TEST: -100 PTS
AND YOU'RE IN COLLEGE??

SPELLING/GRAMMAR ERROR:
NOT ON MY WATCH.

WWW.PHDCOMICS.COM
What is a Presentation?

Presentations are brief discussions of a focused topic delivered to a group of listeners to impart knowledge or to stimulate discussion. They are similar to short papers with an introduction, main body, and conclusion. The ability to give brief presentations is a learned skill and one that is called on frequently in the workplace. Oral presentations typically involve three important steps: planning, practicing, and presentation. MS PowerPoint and Prezi are among many versatile mediums that aid in the giving of presentations and lectures.

Planning

Preparation is the key to giving an effective presentation and to controlling your nervousness. Know your topic well. You will be the expert on the topic in the classroom. After your research, you will find that you know much more about your topic than you will have time to present. That is a good thing to distill out the main, most important points that need to be made, and to finish with a strong conclusion.

Make sure to address the following issues:

**Audience**

- Focus your presentation on the audience. Your presentation is not about how much you can say, but about how much your audience can understand.
- Build repetition. Listening is much different than reading. Your audience cannot go back and read over something they missed or did not understand. Build repetition through internal summaries, transitions, analogies, and stories.

**Introduction**

- Introduce yourself if needed, providing your affiliation and/or credibility.
- Create an effective opening that will engage your audience: pose a question, give an amazing fact, or tell a short, interesting story. By getting the audience involved, you keep them alert and attentive, while also taking some pressure off you.
- Reveal your topic to the audience and explain why it is important.
- Give a brief outline of the major points you will cover in your presentation.
**DON'T DO THIS**

An often heard, but poor start of presentation is:

"Good morning, ladies and gentlemen. I am...and I'd like to tell you about my project. The title of my talk is...I will start with an introduction, then explain my methods, next present the most important results, and finally I hope to draw a few conclusions and I want to acknowledge a few people. So let us start with the introduction..."

If you open this way, you will find yourself in the company of many others. Nevertheless, this is not the way to start a lecture. How would you respond if you were in the audience?

**Main body**

- Explain your points. Give clear explanations. Provide sufficient evidence to be convincing.
- Organize your information into three to five points/categories. Audiences can only easily remember a maximum of three to five points.
- Use transitions between sections of your presentation, as well as between points in your main body section.
- Use analogies and stories to explain complicated ideas and to build repetition.

**Conclusion**

- Signal your conclusion with a transition.
- Summarize your points.
- Refer to future action if needed.
Practicing

Practicing your presentation is essential. It is at this stage of the process that you figure out word and phrase emphasis and the timing of your sections and overall presentation.

- Record your presentation and review it to know how you sound and appear to your audience. You may notice that you are pausing awkwardly, talking too fast, or using distracting gestures.
- Consider using different colored highlighters to remind yourself when to pause, when to emphasize a particular point, when you have a slide change on your PowerPoint, etc.
- Practice in front of peers and elicit feedback. Ask your peers to comment on your delivery and content. What aspects of your delivery work well to convey the information and argument of the presentation, and what aspects of your delivery are not working as well as they could?

Presenting

As the person in charge of the situation when presenting, it is your job to make your audience feel comfortable and engaged with both you and the material of the presentation.

- Maintain eye contact. Only look at notes or slides very briefly. Sweep the room with your gaze, pausing briefly on various people.
- Be aware of your body posture.
- Be enthusiastic about your topic.
- A good slide in PowerPoint makes no more than 2 or 3 points, and these points should augment, emphasize, and explain the speaker's words.
- For complicated subject matter, use 2 or 3 simple figures rather than one complex, cluttered and unclear figure. A series of slides that build on each other is very effective.
- Word slides should contain no more than 5 short statements. The information on the slide should be simplified to the point of being skeletal. It is up to the presenter to fill in gaps. You should NEVER have more than 30 words on a slide. 20 would be better.
  - Smile.
  - **Slow down your speech.** We naturally talk faster when we are nervous. Include pauses to allow your listeners to keep up and time for you to think ahead. A good average is **one slide per minute of talk.** If you have more, you are going too fast for the audience.
  - Use gestures to emphasize points and move about the space if possible.
  - Calibrate the volume of your voice so that people in the back of the room can hear you.
  - Avoid fillers, such as “Ah, uh, I mean, like, okay, um....”
Questions and answers

Do not underestimate the challenge of running a successful question and answer session. They are unpredictable by nature. In your planning, try to anticipate possible questions your audience might have. Follow this four-step process to successfully answer audience questions:

- Acknowledge the question. (“Good Question!”) This polite gesture shows your interest.
- Rephrase the question. This important step allows you to: make sure you understand the question, ensure all audience members hear the question, phrase the question into one you want to or are willing to answer, and gain time to think about your answer.
- Answer the question as clearly and concisely as possible.
- Check for comprehension with the questioner and your audience. (“Does that make sense? Is that clear?”)
Ten Simple Rules for Making Good Oral Presentations

Philip E. Bourne

Continuing our "Ten Simple Rules" series [1-5], we consider here what it takes to make a good oral presentation. While the rules apply broadly across disciplines, they are certainly important from the perspective of this readership. Clear and logical delivery of your ideas and scientific results is an important component of a successful scientific career. Presentations encourage broader dissemination of your work and highlight work that may not receive attention in written form.

Rule 1: Talk to the Audience
We do not mean face the audience, although gaining eye contact with as many people as possible when you present is important since it adds a level of intimacy and comfort to the presentation. We mean prepare presentations that address the target audience. Be sure you know who your audience is—what are their backgrounds and knowledge level of the material you are presenting and what they are hoping to get out of the presentation? Off-topic presentations are usually boring and will not endear you to the audience. Deliver what the audience wants to hear.

Rule 2: Less is More
A common mistake of inexperienced presenters is to try to say too much. They feel the need to prove themselves by proving to the audience that they know a lot. As a result, the main message is often lost, and valuable question time is usually curtailed. Your knowledge of the subject is best expressed through a clear and concise presentation that is provocative and leads to a dialog during the question-and-answer session when the audience becomes active participants. At that point, your knowledge of the material will likely become clear. If you do not get any questions, then you have not been following the other rules. Most likely, your presentation was either incomprehensible or trite. A side effect of too much material is that you talk too quickly, another ingredient of a lost message.

Rule 3: Only Talk When You Have Something to Say
Do not be overeager about what you think you will have available to present when the time comes. Research never goes as fast as you would like. Remember the audience's time is precious and should not be abused by presentation of uninteresting preliminary material.

Rule 4: Make the Take Home Message Persistent
A good rule of thumb would seem to be that if you ask a member of the audience a week later about your presentation, they should be able to remember three points. If these are the key points you were trying to get across, you have done a good job. If they can remember any three points, but not the key points, then your emphasis was wrong. It is obvious what it means if they cannot recall three points.

Rule 5: Be Logical
Think of the presentation as a story. There is a logical flow—a clear beginning, middle, and end. You set the stage (beginning), you tell the story (middle), and you have a big finish (the end) where the take-home message is clearly understood.

Rule 6: Treat the Floor as a Stage
Presentations should be entertaining, but do not overdo it and do know your limits. If you are not humorous by nature, do not try and be humorous. If you are not good at telling anecdotes, do not try and tell anecdotes, and so on. A good entertainer will captivate the audience and increase the likelihood of obeying Rule 4.

Rule 7: Practice and Time Your Presentation
This is particularly important for inexperienced presenters. Even more important, when you give the presentation, stick to what you practice. It is common to deviate, and even worse to start presenting material that you know less about than the audience does. The more you practice, the less likely you will be to go off on tangents. Visual cues help here. The more presentations you give, the better you are going to get. In a scientific environment, take every opportunity to do journal clubs and become a teaching assistant if it allows you to present. An important talk should not be given for the first time to an audience of peers. You should have delivered it to your research collaborators who will be kinder and gentler but still point out obvious discrepancies. Laboratory group meetings are a fine forum for this.

Rule 8: Use Visuals Sparingly but Effectively
Presenters have different styles of presenting. Some can captivate the audience with no visuals (rarely), others require visual cues and in addition, depending on the material, may not be able to present a particular topic well without the appropriate visuals such as graphs and charts. Preparing good visual materials will be the subject of a further Ten Simple Rules. Rule 7 will...
Rule 9: Review Audio and/or Video of Your Presentations

There is nothing more effective than listening to, or watching, a presentation you have made. Violations of the other rules will become obvious. Seeing what is wrong is easy, correcting it the next time around is not. You will likely need to break bad habits that lead to the violation of the other rules. Work hard on breaking bad habits; it is important.

Rule 10: Provide Appropriate Acknowledgments

People love to be acknowledged for their contributions. Having many gratuitous acknowledgements degrades the people who actually contributed. If you defy Rule 7, then you will not be able to acknowledge people and organizations appropriately, as you will run out of time. It is often appropriate to acknowledge people at the beginning or at the point of their contribution so that their contributions are very clear.

As a final word of caution, we have found that even in following the Ten Simple Rules (as perhaps thinking we are following them), the outcome of a presentation is not always guaranteed. Audience-presenter dynamics are hard to predict even though the metric of depth and intensity of questions and off-line followup provide excellent indicators. Sometimes you are sure a presentation will go well, and afterward you feel it did not go well. Other times you dread what the audience will think, and you come away pleased as punch. Such is life. As always, we welcome your comments on these Ten Simple Rules by Reader Response.

Acknowledgments

The idea for this particular Ten Simple Rules was inspired by a conversation with Fiona Addison.

Funding. The author received no specific funding for this article.

Competing Interests. The author has declared that no competing interests exist.

References


What if I can't afford publication charges?

We realize that not everyone who does medical research can afford to pay publication charges through their grants. PLoS waives those fees, no questions asked. Are you can't pay. Our editors and peer reviewers have no knowledge of who can pay, so papers are accepted only on their merit.
# EVALUATION FORM FOR ORAL PRESENTATIONS

**Topic:** ____________________________________________________

**Presenter:** ___________________________________________________________________________________________

<table>
<thead>
<tr>
<th>Scale: Superior</th>
<th>10</th>
<th>Average</th>
<th>7</th>
<th>Inadequate</th>
<th>4</th>
<th>Poor</th>
<th>1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ITEM</th>
<th>COMMENTS</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELIVERY: Poised, well-rehearsed, good eye contact, no distracting gestures or mannerisms, pleasing voice, loud enough, not too fast or slow, spoke clearly, stayed within time limit, used appropriate scientific language, did not read speech, did not turn back on audience when using visual aids, recognized audience reaction and adjusted delivery accordingly, fielded questions with poise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORGANIZATION: Logical presentation of ideas. <em>Introduction:</em> Captured audience interest, clearly stated objectives, gave relevant background information from the literature <em>Body:</em> Described methods in sufficient detail for audience to understand how experiment was carried out; presented results clearly, used effective visuals <em>Closing:</em> Summarized results, gave possible explanations for results, compared results to those in the literature, pointed out errors or inconsistencies, discussed possible implications for or applications to daily life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THOROUGHNESS OF RESEARCH: Speaker showed knowledge of the subject, cited recent journal articles</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## MARKING RUBRIC FOR ORAL PRESENTATIONS

**Topic:**

**Presenter:**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Poor (1)</th>
<th>Acceptable (2)</th>
<th>Good (3)</th>
<th>Excellent (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization / Clarity</strong></td>
<td>Ideas are not presented in proper order; transitions are lacking between major ideas; several parts of presentation are wordy or unclear.</td>
<td>Some ideas are not presented in proper order; transitions are needed between some ideas; some parts of presentation may be wordy or unclear.</td>
<td>Most ideas are in logical order with adequate transitions between major ideas; presentation is generally clear and understandable.</td>
<td>Ideas are presented in logical order with effective transitions between major ideas; presentation is clear and concise.</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>Topic lacks relevance or focus; presentation contains multiple fact errors.</td>
<td>Topic would benefit from more focus; presentation contains some fact errors or omissions.</td>
<td>Topic is adequately focused and relevant; major facts are accurate and generally complete.</td>
<td>Topic is tightly focused and relevant; presentation contains accurate information with no fact errors.</td>
</tr>
<tr>
<td><strong>Style/Delivery</strong></td>
<td>Low volume; pace too slow or fast; poor diction; distracting gestures or posture; little or no eye contact with audience; visual aids poorly used.</td>
<td>More volume needed at times; pace too slow or fast; some distracting gestures or posture; visual aids could be improved; additional eye contact needed at times.</td>
<td>Adequate volume; good pace and diction; few or no distracting gestures; visual aids used adequately; fairly good eye contact with audience.</td>
<td>Good volume; proper pace and diction; avoidance of distracting gestures; visual aids used effectively; good eye contact with audience.</td>
</tr>
<tr>
<td><strong>Use of Visual Aids</strong></td>
<td>Mostly text and few charts explained; labeling unclear and font too small to see; presentation contains several major grammar/usage errors; sentences are incomplete or contain excessive jargon.</td>
<td>Blocks of text and some charts unexplained; labeling a bit unclear and font may be too small; presentation may contain some grammar errors; sentences may contain jargon or hard to follow.</td>
<td>Few texts and charts mostly explained; labeling and font size clear; presentation has no serious grammar errors; sentences are mostly jargon-free, complete and understandable.</td>
<td>Well placed charts with excellent explanation; labeling and font size clear; presentation contains no grammar errors; sentences are free of jargon, complete and easy to understand.</td>
</tr>
<tr>
<td><strong>Integration of Knowledge</strong></td>
<td>Little or no message support provided for major ideas; little or no referencing provided; poor listening skills; uneasiness or inability to answer audience questions.</td>
<td>Some message support provided by facts and visual aids; referencing may be outdated or thin; better listening skills needed; some difficulty answering audience questions.</td>
<td>Adequate message support provided key concepts by facts and visual aids; referencing is generally adequate and current; displays ability to listen; provides adequate answers to audience questions.</td>
<td>Effective message support provided in the form of facts and visual aids; referencing is current and supports major ideas; excellent listening skills; answers audience questions with authority and accuracy.</td>
</tr>
</tbody>
</table>
CHAPTER 9

A GUIDELINE FOR POSTER PRESENTATIONS

What is a Poster?

A poster is very different from a paper or a talk, and so different techniques need to be used in its preparation. In particular, a poster is not a conference paper, and simply pinning a paper to a poster board usually makes a very poor poster. A poster board can vary in size, but the maximum dimensions for printing are $3 \times 4$ ft (i.e., approximately $90 \times 120$ cm). This can easily be set up by changing the size of the slide in Page Layout (located within the Design tab) of MS PowerPoint. A poster itself is a visual presentation comprising whatever the contributor wishes to display on the poster board.

The purpose of a poster is to outline a piece of work in a form that is easily assimilated and stimulates interest and discussion. The ultimate aim is a fruitful exchange of ideas between the presenter and the people reading the poster, but you should not be disappointed if readers do not stop to chat – a poster will at least have given useful information and food for thought.

A Poster Tells a Story

In preparing a poster, simplicity is the key. A typical reader may spend only a few minutes looking at the poster, so there should be a minimum of clutter and a maximum of pithy, informative statements and attractive, enlightening graphics. A poster should tell a story. As always in a scientific presentation, the broad outline includes a statement of the problem, a description of the method of attack, a presentation of results, and then a summary of the work. But within that format, there is much scope for ingenuity.

A poster SHOULD NOT contain a lot of details – the presenter can always communicate the fine points to interested participants. Keep in mind that the poster will be one of many in the exhibition area: You need to make sure that it will capture and hold the reader's attention.

The poster should begin with a definition of the problem, together with a concise statement of the motivation for the work. It is not necessary to write in complete sentences as sentence fragments may be easier to comprehend. Bulleted lists are effective. For presenting results, graphs and figures are easier to scan than the columns of a table (more appropriate for a paper). Legends should be minimal. A brief description of the implications of a graphic, placed just above or below it, is helpful.

Designing Your Poster

If the sheets are arranged as a matrix, two layouts are possible: horizontal (reading across the rows) and vertical (reading down the columns). While the horizontal ordering is
perhaps more natural, it has the major disadvantage of requiring the reader to move to and along the poster. If there are many readers, congestion can result. A vertical ordering is preferable, although other possibilities can be considered. If there is any doubt about the order in which the sheets should be read, guide the reader by numbering the sheets clearly or linking them with arrows.

Think carefully about the use of the poster board. One extreme is to spread the sheets out to make full use of the board – taking care to position them at a height at which they can be read by both the short and the tall. If there are only a few sheets, it may be best to concentrate them in a small area, where a reader can proceed from beginning to end while standing in one position.

For areas of particular emphasis try different shapes to attract the viewer’s attention.

A large and/or bright center of interest can draw the eye to the most important aspect of the poster.

**Lettering and Figures**

Whatever the size of the poster, the text should be considerably large (at least 18 point font size) to be easily read by a person standing a few feet away. In particular, the title of the poster and the author’s name should be large and prominent. For added interest, try including an appropriate cartoon, photograph, or quotation. There is plenty of scope for creativity.

**Poster Evaluation**

All poster material must be typed and printed (i.e., no hand-written text). The following web-page may provide more specific information for designing and presenting your poster. Three examples are provided to illustrate good and bad poster designs.

Hibernation of the Canadian Toad in Wood Buffalo National Park
Katie White, Aurora College, Fort Smith, NT, X0E 0P0, katie.w.mcnabb@gmail.com

1 Introduction
32% of amphibian species are in danger of extinction. Future research on individual populations is needed for effective conservation. The Canadian toad (Bufo hemiophrys) is at its most northern range in the NWT. Suitable hibernation habitat is key to survival and may be the largest limiting factor to this species.

2 Objective
The objectives are to examine population dynamics and habitat requirements of Canadian toads in Wood Buffalo National Park (WBNP). Using existing emergent hole data I will illustrate annual changes in population numbers since 1989.

I will then describe hibernaculum habitat characteristics based on data collected during the 2013 emergent hole survey.

3 Methods
Population estimates on toads in WBNP are made by counting holes following hibernation. Emergent hole surveys for 2013 were conducted as part of this research project on May 27 and June 10 2013.

Physical characteristics such as size, slope, vegetation, and vicinity to wetlands was recorded at each hibernation site. Soil samples were also collected and will be analyzed for colour, texture, percent moisture, and pH.

4 Management Implications
Canadian toads were observed at their hibernation sites long after spring emergence and initial survey. Timing and method of the emergent hole surveys may need to be revised.

Local protection of the hibernaculums through education, outreach, and communication with certain parties, such as the HWY department, is needed to conserve and better understand this population.

4 Results
I predict that population dynamics will show natural fluctuations over time. I also predict that the hibernation sites closest to wetlands will be the most important to their survival.

References

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Time activity budget of Piping Plovers in relation to human disturbance, predators and the weather.

Craig Robinson, Aurora College, NT.

The Piping Plover (Charadrius melodus) is listed as an endangered species by COSEWIC (Committee on the Status of Endangered Wildlife in Canada). The current number of Piping Plovers on the Atlantic coast is roughly 3-520. Predation, changing weather systems and human disturbance are affecting their reproductive success.

Objectives of this study:
- Identify human disturbance as a factor that causes Piping Plovers to spend more time being vigilant and less time foraging.
- Identify the presence of predators as a factor that causes Piping Plovers to spend more time being vigilant and less time foraging.
- Identify weather conditions that are ideal for Piping Plover activity.

Human Disturbance
- Habitats that make good breeding grounds for Piping Plovers are also good recreational areas for people.
- People can be viewed by the birds as potential predators. This can affect the Plovers negatively as they may become unnecessarily stressed and spend their energy running from danger instead of focusing on foraging and preening.
- Rather et al. (2006) found that human recreation is a factor in Piping Plover (Charadrius melodus) chick survival. Chick loss rate was 70.5% higher on holidays and weekends than on weekdays, suggesting that human activities are a factor in chick survival.

Predators
- McIvor et al. (2012) found that chick foraging rates were negatively impacted by the presence of crows within 50 m.
- The presence of crows had ten times the impact than the presence of humans on the beach.
- A crow flying overhead was observed to elicit a defence call from an adult and send chicks running to safety.
- Clark et al. (2005) found that the percentage of chicks that fledged increased with the number of crows (1.7 to 4.5) and fewer (0.0% to 17%) that were trapped.

Changing Weather Systems
- Many people visit the Piping Plover for birding, sunbathing, and time close to the shore.
- A study by Ivey et al. (2013) observed a sudden decline in 4% of Piping Plover nests located on beaches along the southeastern coast of Long Island, NY.
- Global warming is causing an increase in severe storms.
- Nests are in danger of being washed out.

Management Implications: Doing this study on a small, man-made, beach that is highly used by people will clearly show which factors have the biggest effect on the behavior of the Piping Plovers.

Time Activity Budget
- A time activity budget is a simple study that catalogues an organism's behaviours and determines what portion of their time is spent on specific activities.
- The time activity budget can also be cross-referenced with other information to find out what factors are affecting the animals' behaviours.

Location: Northeast Point Beach on Cape Sable Island, NS (roughly 400m by 200m). The beach is small and highly used by people. The beach is a sand spit resulting from a causeway that connects the island to the mainland.

Methods: Record the number of people, number of predators and the weather each day.
- 1 hour observation sessions at low tide every day for 12 days.
- Record the location of the Piping Plover and what activity it is doing.
- Record one data point every 60 seconds for 1 hour.
Ten Simple Rules for a Good Poster Presentation

Thomas C. Erren*, Philip E. Bourne

Posters are a key component of communicating your science and an important element in a successful scientific career. Posters, while delivering the same high-quality science, offer a different medium from either oral presentations [1] or published papers [2], and should be treated accordingly. Posters should be considered a snapshot of your work in progress, an opportunity to engage colleagues in a discussion about the work, or, if you are not present, to be a summary that will encourage the reader to want to learn more. A lifelong collaboration [3] has begun in front of a poster board. Here are ten simple rules for maximizing the return on the time-consuming process of preparing and presenting an effective poster.

Rule 1: Define the Purpose
The purpose will vary depending on the status and nature of the work being presented, as well as the intent. Some posters are designed to be used again and again, for example, those making conference attendees aware of a shared resource. Others will likely be used once at a conference and then be relegated to the wall in the laboratory. Before you start preparing the poster, ask yourself the following questions: What do you want the person passing by your poster to do? Engage in a discussion about the content? Learn enough to go off and want to try something for themselves? Want to collaborate? All of the above, or none of the above but something else? Style your poster accordingly.

Rule 2: Sell Your Work in Ten Seconds
Some conferences will present hundreds of posters, you will need to fight for attention. The first impressions of your poster, and to a lesser extent what you might say when standing in front of it, are crucial. It is analogous to being on an elevator and having a few seconds to peak someone’s interest before they get off. The sad truth is that you have to sell your work. One approach is to pose your work as addressing a decisive question, which you then address as best you can. Once you have posed the question, which may well also be the motivation for the study, the focus of your poster should be on addressing that question in a clear and concise way.

Rule 3: The Title Is Important
The title is a good way to sell your work. It may be the only thing the conference attendee sees before they reach your poster. The title should make them want to come and visit. The title might pose a decisive question, define the scope of the study, or hint at a new finding. Above all, the title should be short and comprehensible to a broad audience. The title is your equivalent of a newspaper headline—short, sharp, and compelling.

Rule 4: Poster Acceptance
Means Nothing
Do not take the acceptance of a poster as an endorsement of your work. Conferences need attendees to be financially viable. Many attendees are there on grants cannot justify attending a conference unless they present. There are a small number of speaking slots compared with attendees. How to solve the dilemma? Enter posters; this way everyone can present. In other words, your poster has not been endorsed, just accepted. To get endorsement from your peers, do good science and present it well on the poster.

Rule 5: Many of the Rules for Writing a Good Paper Apply to Posters, Too
Identify your audience and provide the appropriate scope and depth of content. If the conference includes non-specialists, cater to them. Just as the abstract of a paper needs to be a succinct summary of the motivation, so does your poster.

Rule 6: Good Posters Have Unique Features Not Pertinent to Papers
The amount of material presented in a paper far outweighs what is presented on a poster. A poster requires you to distill the work, yet not lose the message or the logical flow. Posters need to be viewed from a distance, but can take advantage of your presence. Posters can be used as a distribution medium for copies of associated papers, supplementary information, and other handouts. Posters allow you to be more speculative. Often only the titles or at most the abstracts of posters can be considered published; that is, widely distributed. Mostly, they may never be seen again. There is the opportunity to say more than you would in the traditional literature, which, for all intents and purposes will be part of the immutable record. Take advantage of these unique features.

Rule 7: Layout and Format Are Critical
Pop music artist Keith Richards put the matter well in an interview with Dave Spiegel [4]. If you are a painter, then the most important thing is the bare canvas. A good painter will never cover all the space but will always leave some

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Thomas C. Erren is with the Institute and Faculty for Occupational and Social Medicine, School of Medicine and Dentistry, University of Cologne, Lindendahl, Germany. Philip E. Bourne is a Professor in the Department of Pharmacology, University of California San Diego, La Jolla, California, United States of America.

* To whom correspondence should be addressed. E-mail: tcrenee@urboeck.de
blank. My canvas is silence.” Your canvas as poster presenter is also white space. Guide the passerby’s eyes from one succinct frame to another in a logical fashion from beginning to end. Unlike the literature, which is linear by virtue of one page following another, the reader of a poster is free to wander over the pages as if they are tackled to the poster board in a random order. Guide the reader with arrows, numbering, or whatever else makes sense in getting them to move from one logical step to another. Try to do this guiding in an unusual and eye-catching way. Look for appropriate layouts in the posters of others and adopt some of their approaches. Finally, never use less than a size 24 point font, and make sure the main points can be read at eye level.

Rule 8: Content Is Important, but Keep It Concise

Everything on the poster should help convey the message. The text must conform to the norms of sound scientific reporting: clarity, precision of expression, and economy of words. The latter is particularly important for posters because of their inherent space limitations. Use first-rate pictorial material to illustrate a poster; it can sometimes transform what would otherwise be a bewildering mass of complex data into a coherent and convincing story. One carefully produced chart or graph often says more than hundreds of words. Use graphics for “clear portrayal of complexity” [5], not to impress (and possibly bewilder) viewers with complex artistry. Allow a figure to be viewed in both a superficial and a detailed way. For example, a large table might have bold swaths of color indicating relative contributions from different categories, and the smaller text in the table would provide gritty details for those who want them. Likewise, a graph could provide a bold trend line (with its interpretation clearly and concisely stated), and also have many detailed points with error bars. Have a clear and obvious set of conclusions—after the abstract, this is where the passerby’s eyes will wander. Only then will they go to the results, followed by the methods.

Rule 9: Posters Should Have Your Personality

A poster is a different medium from a paper, which is conventionally dry and impersonal. Think of your poster as an extension of your personality. Use it to draw the passerby to take a closer look or to want to talk to you. Scientific collaboration often starts for reasons other than the shared scientific interest, such as a personal interest. A photo of you on the poster not only helps someone find you at the conference when you are not at the poster, it can also be used to illustrate a hobby or an interest that can open a conversation.

Rule 10: The Impact of a Poster Happens Both During and After the Poster Session

When the considerable effort of making a poster is done, do not blow it on presentation day by failing to have the poster achieve maximum impact. This requires the right presenter-audience interaction. Work to get a crowd by being engaging; one engaged viewer will attract others. Don’t badger people, let them read. Be ready with Rule 2. Work all the audience at once, do not leave visitors waiting for your attention. Make eye contact with every visitor. Make it easy for a conference attendee to contact you afterward. Have copies of relevant papers on hand as well as copies of the poster on standard-sized paper for work that is more mature, have the poster online and make the URL available as a handout. Have your e-mail and other demographics clearly displayed. Follow up with people who come to the poster by having a signup sheet. The visitor is more likely to remember you than the content of your poster. Make yourself easy to remember. As the host of the work presented on the poster, be attentive, open, and curious, and self-confident but never arrogant and aggressive.

Leave the visitors space and time—they can “travel” through your poster at their own discretion and pace. If a visitor asks a question, talk simply and openly about the work. This is likely your opportunity to get feedback on the work before it goes to publication. Better to be tripped up in front of your poster than by a reviewer of the manuscript.

Good posters and their presentations can improve your reputation, both within and outside your working group and institution, and may also contribute to a certain scientific freedom. Poster prizes count when peers look at your resume.

These ten rules will hopefully help you in preparing better posters. For a more humorous view on what not to do in preparing a poster, see [6], and for further information, including the opportunity to practice your German, see [7].

Acknowledgments

Thomas A. M. E. Venn’s contributions to this piece are based on [7] and were stimulated by exchanges with Michael Jacobson. Thanks also to Steven E. Brenner for useful input.

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Competing interests. The authors have declared that no competing interests exist.

References

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**Presenter:** ___________________________________________________________________________________________

**Scale:**

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<tr>
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<th>Average</th>
<th>Inadequate</th>
<th>Poor</th>
</tr>
</thead>
</table>

## Layout and Appearance

| **APPEARANCE:** Is the poster neatly constructed? Do the text and the figures stand out against the background? Are colors and fonts used consistently? Is the text large and legible from 3–6 ft away? |
| **SECTIONS:** Does each section begin with a descriptive heading? Is there sufficient space between sections? Do the sections naturally flow from top left to bottom right? |
| **BALANCE:** Is there a nice balance between text and figures? Is there too much text? |
| **PROOFREADING:** Is the text free of typos and grammatical errors? |

## Content

| **TITLE:** Does the title grab your attention? |
| **AUTHORS:** Are the authors’ names, affiliations, and contact information provided? |
| **INTRODUCTION:** Were the objectives clearly stated? Do you understand why this study was done? Did you get enough background information to understand the system? Were any abbreviations defined for the general visitor? Were the hypotheses rational? |
| **METHODS:** Were the methods described clearly and concisely? |
| **RESULTS:** Were the graphs easy to understand? Were any graphics distracting? |
| **DISCUSSION:** Do the conclusions match the data? Are reasonable ideas put forth to explain the observed patterns? Is there a clear connection between the conclusions and the original objectives? |