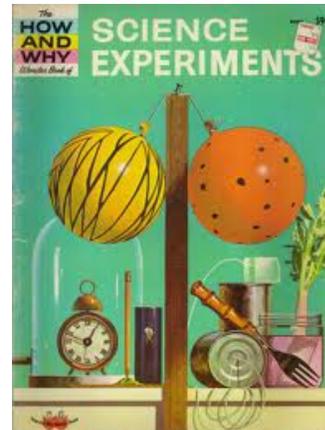
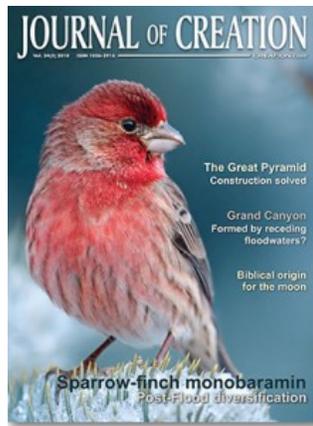


Writing a Scientific Research Paper



Based upon a compilation by Marc E. Tischler, Ph.D.
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Scientific Writing Booklet

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Writing a Scientific Research Paper

What is a scientific research paper?

Professor Gary Dillard from the Department of Biology at Western Kentucky University offers a succinct definition of the scientific paper in one of his biology courses, "**The scientific paper is a written and published report describing original research results.**"

The Department of Biology at George Mason University offers a slightly longer, more detailed definition of the scientific paper in their *Guide to Writing in the Biological Sciences*: **A well-written scientific paper explains the scientist's motivation for doing an experiment, the experimental design and execution, and the meaning of the results. Scientific papers are written in a style that is exceedingly clear and concise.** Kristi Dyer, M.D. notes that the importance of clarity and conciseness cannot be over-stressed!

For some helpful tips on writing clearly and concisely by Rebecca Bartow, an instructor at Western Kentucky University at Bowling Green, see Appendix A.

Differences Between the Purpose of Science Papers & Humanities Papers

Writing a science paper can be overwhelming at first, particularly if the only writing style you have encountered is the traditional MLA (Modern Language Association) style of writing used when writing papers for humanities and English courses. Understanding how these two types of papers (English and Science) differ in the type of research done, the purpose of writing and the style of writing, it will make writing a scientific paper much easier. To help in understanding the differences in writing genres, take a look at Appendix B (page 22-25) of this guide.

English and humanities papers are based on arguments (a thesis statement), in which writers attempt to convince their readers that the claims being made about the topic or a text in question are valid. The purpose of such papers is to persuade the reader and to provide compelling examples or instances to back up the thesis statement. Oftentimes, these papers are short (4-6 pages) in length.

At the Dartmouth Writing Program, Karen Gocsik describes the purpose of writing a science paper as the search for truth, to find *one* correct answer to a problem. Additionally, scientists and researchers write for two reasons: 1) to inform the community of new discoveries; and 2) to help the scientific community arrive at a consensus about the truth. Published science papers measure and describe various observations and phenomenon and follow a more rigid format. Gocsik notes that "It is not important when writing a scientific paper to be eloquent. It is absolutely important, however, that you be clear."

In the humanities, often the focus of the paper is on the interpretation of texts, not on the interpretation of hard evidence. Paragraphs and sentences are usually longer and more eloquent. Papers may include imagery, sensory detail, and the use of metaphors. Voice is active, not passive.

In the humanities or liberal arts paper, the author is asked to write in MLA (Modern Language Association) style. Sometimes the essays are divided into several sections with headings.

The writing styles in the sciences vary by the type of science. Social sciences and some other sciences authors use the APA (American Psychological Association) style. Many of the biomedical and science manuscripts follow the URM (Uniform Requirements for Manuscripts) style of formatting papers and are written according to the American Medical Association Manual of Style or in CSE style (Council of Science Editors Scientific Style and Format). The McCarthy Library has the 8th edition of the CSE Manual (REF 808.066 Scientific) and the 6th edition of the Publication Manual of the APA (REF 808.06615 Publication) **Follow your instructor's requirements for the proper citation style to use.**

Key to writing and effectively organizing or formatting the scientific research paper is to understand the different sections or parts that are typically included in a scientific research paper, journal article or medical manuscript.



Rebecca Bartow, Ph.D., an instructor at Western Kentucky University helps to simplify the organization of a scientific paper by using the IMRAD Approach:

I - Introduction: What problem (question) was studied?

M – Methods: How was the problem studied?

R – Results: What were the findings?

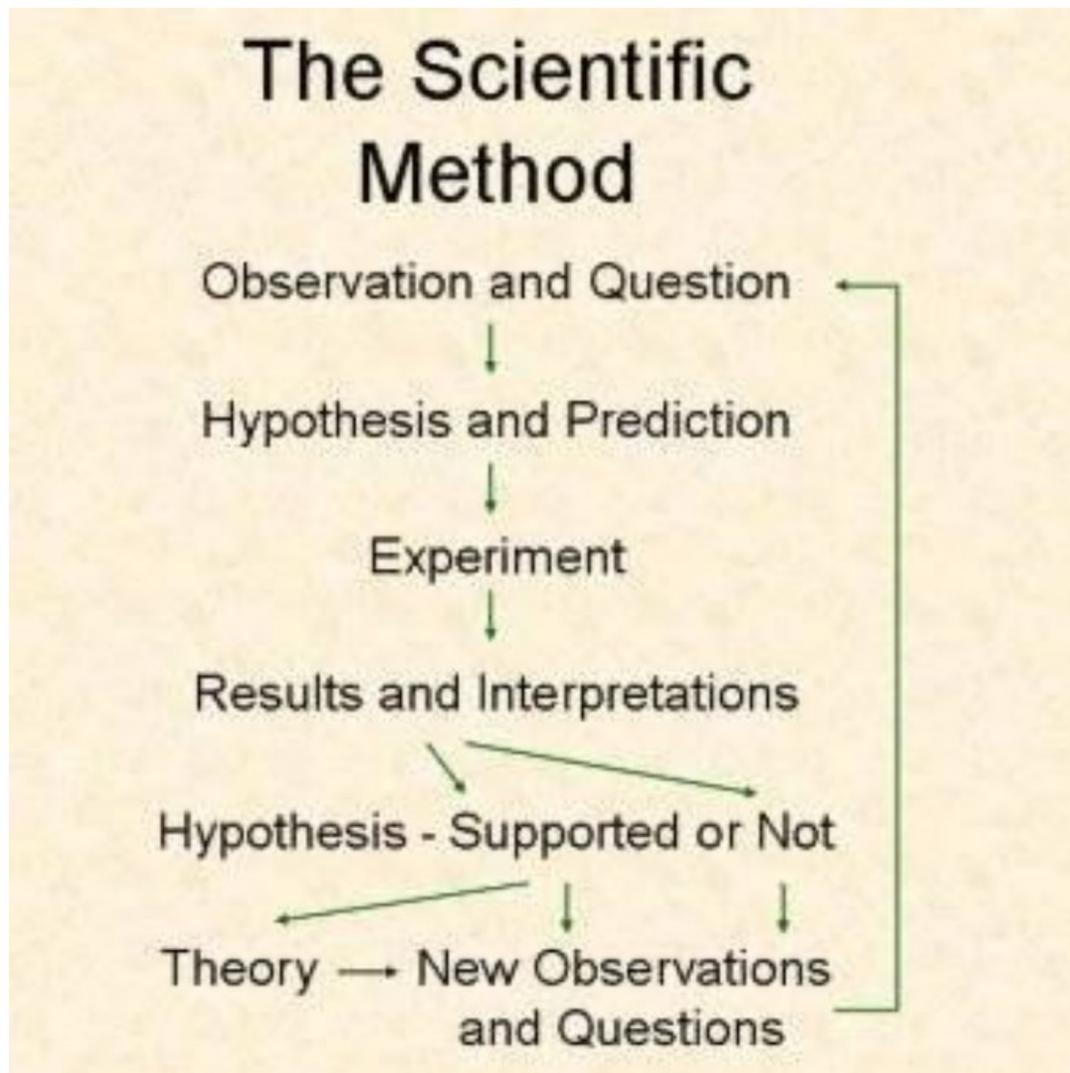
A – and

D – Discussion: What do these findings mean?



Following the Scientific Method to Answer a Question

There are two main types of science papers that are assigned, **the lab report** and the **review of the literature**. Both of these different types of science papers require that you follow the Scientific Method, a more systematic approach to problem solving (Dyer).

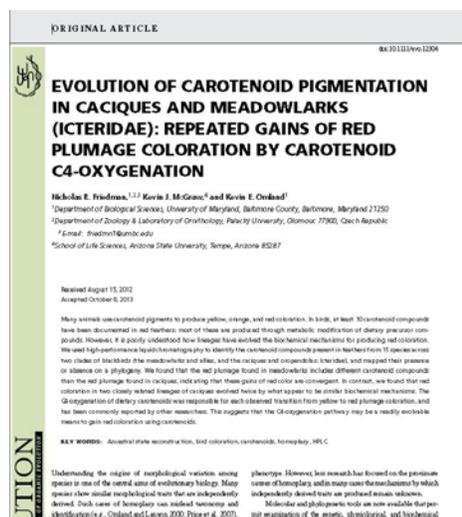
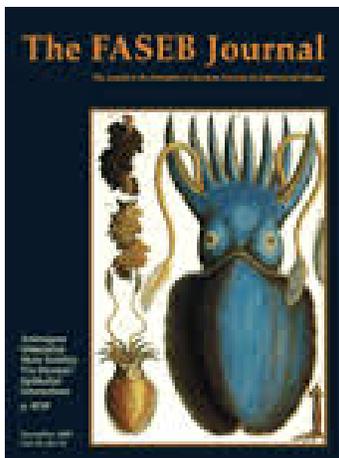


The different steps in the Scientific Method include:

- **Observation and Question** – A problem to be solved is identified or the researcher asks a specific question.
- **Hypothesis and Prediction** – A hypothesis, a tentative solution to the problem or answer to the question, is formulated and a prediction is made that can be tested.
- **Experiment** – A study is designed and the research is conducted to collect relevant data.
- **Results and Interpretations** – The collected data is summarized, analyzed and interpreted. Conclusions are drawn based on the observations.
- **Theory** – A theory may be developed that integrates the findings from their study with findings from other studies.

With the sciences, sometimes a hypothesis is supported by the data and a theory may be developed and other times the hypothesis is not supported. If the data does not support the hypothesis it is "back to the drawing board" to start the process over again.

Robert A. Day says in *How to Write and Publish a Scientific Paper*, "A scientific experiment, no matter how spectacular the results, is not completed until the results are published. In fact, the cornerstone of the philosophy of science is based on the fundamental assumption that original research must be published; only then can new scientific knowledge be authenticated and added to the existing database called scientific knowledge" (Bartow).





The Big Picture: Sections of a Scientific Research Paper

There are several important steps to follow when writing a science paper. The actual required sections may vary a bit depending on your assignment, but most include the following sections in a scientific research paper:

- **Introduction** – Clearly states the purpose of the paper with a hypothesis, thesis or topic sentence.
- **Abstract** – States the principal objectives and scope of the investigation, describes the methods used, summarizes the results, and states the principal conclusions in less than 250 words (maximum).
- **Review of Literature** – Provides an extensive search of the literature to discover what is known about the subject to date. This also includes how the search of the literature was conducted.
- **Methodology or Materials and Methods** – The section where key terms are described. Also included are the research instruments and procedures used in conducting the study, or researching the topic.
- **Results** – This is where the findings are reported. This section may include tables and figures that summarize the data or information.
- **Discussion** – This is the main body of the paper, the section for reporting findings, sharing thoughts and analysis of the results.
- **Conclusions** – The conclusions presented in the paper are those supported by the data. They also reflect the original purpose for the paper from the introduction. Researchers often answer a few questions, but raise several more to pursue in future research projects.
- **References** – References should include an extensive list of relevant studies discovered reviewing the literature. Ideally important older studies are included along with current, newer ones.
- **Abbreviations** – A list of all abbreviations (shortened form of a word or phrase used for brevity in place of the whole) used in the manuscript or paper.
- **Tables** – A set of data organized and arranged in rows and columns.
- **Figures** – A diagram, picture or photograph illustrating material from the text or research data.
- **Appendix** – Supplementary material appended or added at the end of the paper such as research data, handouts. These may include tables, figures and multimedia sources.

Writing the Introduction

The first step is to decide on the content of the Introduction. It may be helpful to meet with your instructor to make sure that the purpose of your paper is clear. You must have a thesis statement, hypothesis or topic sentence. **Be sure to describe the problem you are investigating. Why was there a need to conduct the study?** (See the chart on page 8 for the components of the introduction). Much of your time before writing must be spent in reading appropriate papers that serve as background to the work you will be doing. The librarian can help you identify scholarly papers related to your topic. As you spend additional time working on your project, you should check the most appropriate journals on a regular basis. Work with your instructor to include the methods you will be using in your study.

The Introduction should begin by introducing the reader to the pertinent literature. **A common mistake is introducing authors and their areas of study in general terms without mentioning their major findings.**

Here's an example of a common mistake:

“Parmenter (2010) and Chessman (2007) studied the diet of *Chelodina longicollis* at various latitudes and Leger (2005) and Chessman (2008) conducted a similar study on *Chelodina expansa*.”



Chelodina longicollis
Australian long-necked turtle



Chelodina expansa
Australian broad-shelled long-necked turtle

It would be much clearer to say:

“Among carnivores, *Chelodina expansa* is a selective and specialized predator feeding upon highly motile prey such as crustaceans, aquatic bugs and small fish (Legler, 2005; Chessman, 2008), whereas *Chelodina longicollis* is reported to eat a diverse and opportunistic diet (Parmenter, 2010; Chessman, 2007).”

This second example is a more informative lead-in to the literature. More importantly, it enables the reader to clearly place the current work in the context of what is already known. An important function of the Introduction is to establish the significance of the current work: **Why was there a need to conduct the study?**

Having introduced the pertinent literature and demonstrated the need for the current study, you should state clearly the scope and objectives. Avoid using bulleted points. Instead, write out your points in complete sentences in your Introduction. The Introduction can finish with the statement of objectives, or, as some students prefer, with a brief statement of the principle findings. Either way, the reader must have an idea of where the paper is heading in order to follow the development of the evidence.

Components of the Introduction (Tischler)

Question to address	How to address
What is the problem?	<ul style="list-style-type: none"> • Describe the problem investigated. • Summarize relevant research to provide context, key terms, and concepts so your reader can understand the experiment.
Why is it important?	<ul style="list-style-type: none"> • Review relevant research to provide rationale. (What conflict or unanswered question, untested population, untried method in existing research does your experiment address? What findings of others are you challenging or extending?)
What solution (or step toward a solution) do you propose?	<ul style="list-style-type: none"> • Briefly describe your <i>experiment: hypothesis(es), research question(s); general experimental design or method; justification of method</i> if alternatives exist.

Additional tips:

1. Move from general to specific: problem in real world/research literature to your experiment.

2. Engage your reader: answer the questions, “What did you do?” “Why should I care?”
3. Make clear the links between problem and solution, question asked and research design, prior research and your experiment.

Writing the Methodology (or Materials and Methods) Section:

The main purpose of the Materials and Methods section is to provide enough detail for another person to repeat your study and reproduce the results. The scientific method requires that your results be reproducible (Tischler).

Often in field-base studies, there is a need to describe the study area in greater detail than is possible in the Introduction. Usually students will describe the study region in general terms in the Introduction and then describe the study site and climate in detail in the Materials and Methods section. The sub-headings “Study Site”, “General Methods” and “Analysis” may be useful.

Equipment and materials available off the shelf should be described exactly (e.g. Licor underwater quantum sensor, Model LI 192SB) and sources of materials should be given if there is variation in quality among supplies. Modifications to equipment or equipment construction specifically for the study should be carefully described in detail. The method used to prepare reagents, fixatives, and stains should be stated exactly, though often reference to standard recipes in other works will be sufficient.



The usual order of presentation of methods is chronological, however, related methods may need to be described together and strict chronological order cannot always be followed. Be sure to provide all of the detail required to repeat the methods. If the method used is well known and has been previously published in a standard journal, only the name of the method and a literature reference need be given.

Be precise in describing measurements and include errors of measurement. Ordinary statistical methods should be used without comment; advanced or unusual methods may require a literature citation. Show your materials and

methods section to your instructor. Ask if they would have difficulty in repeating your study.

Guidelines for effective Methodology (Materials and Methods) sections in scientific reports (Tischler)

Questions to address:	How to address them:
How did you study the problem?	<ul style="list-style-type: none"> Briefly explain the general type of scientific procedure you used.
What did you use? (May be listed as Materials)	<ul style="list-style-type: none"> Describe what materials, subjects, and equipment (chemicals, experimental animals, apparatus, etc.) you used. May be listed as animals, reagents, etc.
How did you proceed? (May be listed as Methods or Procedures)	<ul style="list-style-type: none"> Explain the steps you took in your experiment. (May be listed as experiment, types of assay, etc.)

Additional Tips:

1. Provide enough detail for replication. For a journal article, for example, provide genus, species, strain of organisms; their source, living conditions, and care; and sources (manufacturer, location) of chemicals and apparatus
2. Order procedures chronologically or by type of procedure
3. Use past tense to describe what you did
4. Quantify when possible: concentrations, measurements, amounts (all metric); times (24-hour clock); temperatures (centigrade)

What to avoid:

1. Don't include details of common statistical procedures.
2. Don't mix results with procedures.

Think about How to Organize, Rearrange and Format the Scientific Paper

After the data has been collected the next steps in writing the scientific paper are researching, interpreting and documenting information. Then the data, information and ideas need to be organized and presented in a logical manner to reach a conclusion about the research. Finally the data and supporting research needs to be put into a written paper in an organized manner using a style that other researchers and scientists can easily understand

Writing the Results and Discussion

Results Section

In the Results section you present your findings. Present the data, digested and condensed, with important trends extracted and described. Because the results comprise new knowledge that you are contributing to the world, it is important that your findings be clearly and simply stated. The Results should be short and sweet, without excessive verbiage (words)!

Do not say:

“It is clearly evident from Fig. 1 that bird species richness increase with habitat complexity”.

Say instead:

“Bird species richness increased with habitat complexity (Fig. 1)”.



Be sure to use text, tables, and figures to condense data and highlight any trends.

A Word About Numbers and Statistics

Follow this guide as you use numbers and statistics in your writing:

- Use symbol \sim to mean *approximately equal to*.
- Numbers beginning a sentence must be spelled. It is usually better to rewrite a sentence so you don't start it with numbers greater than ninety-nine.
- Note: one, two, three...nine, 10, 11, 12... Exceptions: a 2-m tape measure; 3 million.
- Put a space between numbers and units: for example 75 kg. Exception: 75%.
- Note: 0.32 is correct, NOT .32.
- Note: write numbers as follows: 143 2,461 or 2461 21,278 1,409,000
- When you quote numbers, make sure you use the minimum number of significant digits or decimal places. For example, 23 ± 7 years is appropriate but not 23.4 ± 6.6 years; the loss of accuracy is not important because the measurement is not significant to the first decimal place.
- Use the appropriate number of digits: two significant digits for standard deviations (one digit if the standard deviation is for a descriptive statistic like height or weight, or if precision is not important); two decimal places for correlations, two significant digits for percentages. Examples: 73 ± 5 ; $r=0.45$; $r = 0.08$; 16%; 1.3%, 0.013%.
- If it is more convenient to show p values than confidence limits, show the exact p value to one significant digit (for $p < 0.1$) or two decimal places (for $p > 0.10$). Rather than using $p < 0.05$ or $p > 0.05$ it may be better to use the following examples: $p = 0.03$; $p = 0.007$; $p = 0.09$; $p = 0.74$ when the exact p value is important for anyone using your data to calculate confidence limits or using your data in a meta-analysis. If you have a table or figure with a large number of comparisons, it may be simpler to use the $p <$ notation to refer to a group of observations.
- Make sure the significant digits of the mean and standard deviation are consistent. Examples: 20 ± 13 ; 0.020 ± 0.013 ; 156 ± 7 ; 1.56 ± 0.07 NOT 1.6 ± 0.07 or 20 ± 13.1 .
- Show 95% confidence intervals for effect statistics like correlation coefficient or the difference between means.



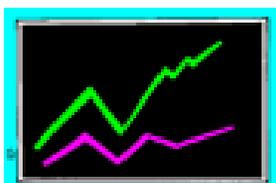
How to Present Your Results (Tischler)

In the Results section, you will be explaining what you observed:

Question to address:	How to address it:
What did you observe?	For each experiment or procedure: <ul style="list-style-type: none">• Briefly describe the experiment (not in as much detail as the Methods section)• Report main result(s), supported by selected data:<ol style="list-style-type: none">1. Representative (most common)2. Best case: best example of ideal or exception

Additional tips:

1. **Order** multiple results logically:
from most to least important
from simple to complex
organ by organ; chemical class by chemical class.
2. **Use past tense** to describe *what happened*.
3. **What to avoid:**
Don't simply repeat table data; **select**.
Don't interpret results.
Avoid extra words:
Not: "It is show in Table 1 that X induced Y"
Better: "X inducted Y (Table 1)."
4. Create tables with the Table pull-down in Word. Do not use tabs.



Writing the Discussion Section

In the Discussion section you should discuss your results. What biological principles have been established or reinforced? What generalizations can be drawn? How do your findings compare to the findings of others or to expectation based on previous work? Are there any theoretical/practical implications of your work? When you address these questions, it is important that your discussion rests firmly on the evidence presented in the Results section. Continually refer to your results (but do not repeat them). Most importantly, do not extend your conclusions beyond those which are directly supported by your results. Speculation has its place, but should not form the bulk of the Discussion section. Be sure to address the objectives of the study in the Discussion section and to discuss the significance of the results. Don't leave the reader thinking, "So what?" End the discussion section with a short summary or conclusion regarding the significance of the work (Tischler).

Questions to address:	How to address them:
What do your observations mean?	<ul style="list-style-type: none"> • Summarize the most important findings at the beginning.
What conclusions can you draw?	<ul style="list-style-type: none"> • Describe the patterns, principles, relationships results show. • Explain how your results relate to expectations and to literature cited in your Introduction. Do they agree, contradict, or are they exceptions to the rule? • Explain plausibly any agreements, contradictions, or exceptions. • Describe what additional research might resolve contradictions or explain exceptions.
How do your results fit into a broader context?	<ul style="list-style-type: none"> • Suggest the theoretical implications of your results. • Suggest practical applications of your results? • Extend your findings to other situations or other species. • Give the big picture: do your findings help us understand a broader topic?

Additional tips:

1. **Move from specific to general:** Your findings(s) → literature, theory, practice.
2. **Don't ignore or bury the major issue.** Did the study achieve the goal (resolve the problem, answer the question, support the hypothesis) presented in the Introduction?
3. **Make explanations complete.**
Give evidence for each conclusion.
Discuss possible reasons for expected and unexpected findings.
4. **What to avoid:**
Don't over generalize.
Don't ignore deviations in your data.
Avoid speculation that cannot be tested in the foreseeable future.

Basic Formatting Requirements for a Research Paper

Before submitting a paper, prepare the final copy on a good quality standard 8½-by-11-inch paper of a common weight and thickness, for example, 16-20 pound bond paper. Moreover, use a font style and size that are readable, and in both APA and MLA, the only acceptable font styles are Times New Roman, Arial, and Courier, while the only acceptable font size is 12-point, except in certain rare circumstances explained in the APA and MLA manuals. Finally, use only black ink and make certain the printed copy is legible, not smeared or the text so light as to be unreadable.

How to Format Margins on Research Papers

Margins should be 1-inch on both sides and at the top and bottom of all pages. Additionally, text in the body of the paper, other than the paper's title on the first page, which is centered, should be aligned left, not justified or aligned right.

Preparing the Reference Section

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. 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 "References" centered at the top of the page (do NOT bold, underline, or use quotation marks for the title). All text should be double-spaced just like the rest of your essay.

Basic Rules for APA Formatting (From Online Writing Lab – Purdue University)

- All lines after the first line of each entry in your reference list should be indented one-half inch from the left margin. This is called hanging indentation.
- Authors' names are inverted (last name first); give the last name and initials for all authors of a particular work for up to and including seven authors. If the work has more than seven authors, list the first six authors and then use ellipses after the sixth author's name. After the ellipses, list the last author's name of the work.
- Reference list entries should be alphabetized by the last name of the first author of each work.
- If you have more than one article by the same author, single-author references or multiple-author references with the exact same authors in the exact same order are listed in order by the year of publication, starting with the earliest.
- Capitalize all major words in journal titles.
- When referring to books, chapters, articles, or Web pages, capitalize only the first letter of the first word of a title and subtitle, the first word after a colon or a dash in the title, and proper nouns. Do not capitalize the first letter of the second word in a hyphenated compound word.
- Italicize titles of longer works such as books and journals.
- Do not italicize, underline, or put quotes around the titles of shorter works such as journal articles or essays in edited collections.
- **Please note:** While the APA manual provides many examples of how to cite common types of sources, it does not provide rules on how to cite all types of sources. Therefore, if you have a source that APA does not include, APA suggests that you find the example that is most similar to your source and use that format. For more information, see page 193 of the *Publication Manual of the American Psychological Association*, sixth edition.

Additional Formatting Guidelines for College Papers

- Double-space the entire paper with no extra spacing between paragraphs.
- Block quotes of 40 or more words and indent them ten spaces.
- When citing a quotation from a source to which the author refers, use the abbreviation “qtd.” in the parenthetical citation, for example: According to Dr. Mason Brown, professor of humanities at Bowling Green University, “The study of the arts is imperative for the development of a civilized populace” (qtd. in Fiedler, 2002, p. 23).
- If you use more than one work by the same author, include an abbreviated version of the title within the parenthetical citation, for example: (Smith, *Musings*, 2008).
- Place a parenthetical citation at the end of the sentence it is referencing and before the period, not after it. However, when using only one source for all information contained within an entire paragraph, place the parenthetical citation after the period in the final sentence, not before it. Note: A parenthetical citation is one enclosed in parentheses.
- Leave only one space after all punctuation, including commas, colons, semicolons, and periods.
- Use an ellipsis mark (spaced periods) to indicate omitted words, phrases, sentences in a direct quote. Use three periods to indicate an omission within a sentence and four periods to indicate an omission between sentences.
- Include headings (in APA) to identify each section of the paper. Main headings are level one, subheadings are level two, and sub-subheadings are level three.

Basic Form: APA Style

APA style dictates that authors are named last name followed by initials; publication year goes between parentheses, followed by a period. The title of the article is in sentence-case, meaning only the first word and proper nouns in the title are capitalized. The periodical title is run in title case (capitalize the first word, the last word, and all major words in between), and is followed by the volume number which, with the title, is also italicized.

Author, A. A., Author, B. B., & Author, C. C. (Year). Title of article. *Title of Periodical*, volume number (issue number), pages.

For a helpful APA crib sheet created by College of Alameda Librarians, go to:

<http://alameda.peralta.edu/library/files/2012/04/APA.pdf>

For Additional Help on styles see:

For Council of Science Editor's Style (CSE) see:

http://writing.wisc.edu/Handbook/DocCSE_CitationSystems.html

For the American Medical Association's Manual of Style see:

<http://www.amamanualofstyle.com/>

For additional guidelines on APA style, go to Purdue Online Writing Lab at:

<http://owl.english.purdue.edu/owl/resource/560/07/>

For Additional Writing Resources see:

Colorado State University's Writing the Scientific Paper

<http://writing.colostate.edu/guides/guide.cfm?guideid=83>

Appendix A – [Effective Biomedical Writing. Based on PowerPoint by Rebecca A. Barlow, Ph.D.]

Clear, concise writing calls for using simple words and avoiding euphemisms:

Simple Words	Avoid Euphemisms
Employ or utilize = use Finalize or terminate = end Initial = first Initiate = start Impact = affect Perform = do Prior to = before Significant = important, great, major (reserve for statistical meaning) Subsequently = after Sufficient = enough	Sacrificed = killed Euthanized = killed Expired = died Females = women Males = men

Use Transition Words to Indicate Relationships

Cause or reason: Because Since (time) Example: For example Sequence: First Addition: In addition Furthermore	Contrast: In contrast However Nevertheless Although Conclusions: Therefore Thus In conclusion In summary
---	---

Avoid Useless Words and Phrases:

Clearly
 Interestingly
 It is evident
 It is apparent
 As a matter of fact
 It is of interest to note
 With reference to

Avoid Wordiness

Take into consideration = consider

Lend support to = support

Arrive at a conclusion = conclude

Have a preference for = prefer

Conduct an investigation = investigate

Serve as a substitute = substitute

At this point in time = now

Due to the fact that = because

A majority of = most

Avoid Redundancy

The samples were pale blue in color (redundant) better: pale blue samples

The phantom is cylindrical in shape (redundant) better: a cylindrical phantom

We obtained a consensus of opinion on the format (redundant)

better: We obtained a consensus on format

The Importance of Grammar and Syntax

After standing in boiling water for an hour, examine the flask. (poor syntax)

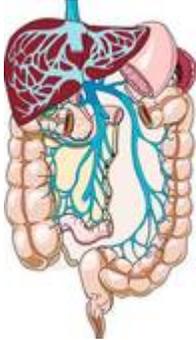
-- Who is standing in boiling water, you or the flask?????

better: Examine the flask after allowing it to stand in boiling water for an hour.

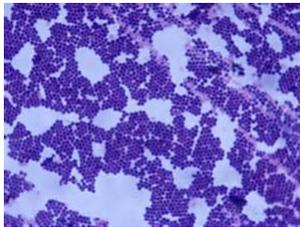


Lying on top of the intestine, you will see a small transparent thread. (poor)
-- Who/what is lying on top of the intestine??????

Better: A small transparent thread lies on top of the intestine.



A large mass of literature has accumulated on the cell walls of staphylococci. (poor)



Better: A large amount of literature can be found about staphylococci on cell walls.

Always

- SpellCheck
- Proofread
- Check your references
- Proofread
- Ask a friend/colleague to read
- Proofread



APPENDIX B

Comparison of Writing Genres

Based upon "Addressing Writing In the Disciplines" by Terry Myers Zawacki

Type of writing assignment (genre)	Course/ discipline	Sample Task, purpose, and rhetorical strategies	Kinds of evidence required	Most prominent textual features called for	Other teacher directives and advice
Personal essay	Composition	Describe a turning point in your life. Narrate the event with lots of specific description.	Personal experience	First person; chronological order; vivid details; dialogue and other story devices	Craft a thesis that explains the point of the narrative and the larger meaning. Use active voice. Don't just summarize in the conclusion. Explain why the story matters.
Argument essay	History	Compare political power in ancient and medieval times. Describe power, and compare it on several points. Argue which is better.	Specific explanations and examples from textbook, lectures and online database articles	Develop a thesis that states the purpose and takes a position. Provide a brief description of the historical context. Compare and contrast three or four main points about each system with evidence.	Don't use first person or offer personal opinion. Avoid passive voice. Do not use contractions. Use past tense. Use <i>Chicago</i> or <i>MLA style</i>

Type of writing assignment (genre)	Course/ discipline	Sample Task, purpose, and rhetorical strategies	Kinds of evidence required	Most prominent textual features called for	Other teacher directives and advice
Argument essay	English	Take a position for or against a topical issue. Describe reasons for and against your position. Explain why your reasons are better.	Personal knowledge backed up with other sources as needed	Start with the context for your argument. State the thesis at the end of the introduction in one sentence, which may also include the points you'll make. In the conclusion, restate the argument and explain why it matters.	You may use first person. Give the strongest points first. Give opposing views either point by point or in one paragraph. Quote or paraphrase opinions from other sources if used. Use <i>MLA style</i> .
Research paper	Psychology	Research and report on studies exploring the causes of autism. Describe studies that have been done and synthesize research findings around your main points.	Experiments; systematic observations; case studies	Develop a thesis that states the purpose of the paper. In your introduction, give definitions and other necessary background. Include descriptions of methods, findings, and conclusions.	Do not use first person or include personal opinions. Summarize the studies. Paraphrase sources. Do not quote. Use <i>APA style</i> . Do not use contraction.

Type of writing assignment (genre)	Course/ discipline	Sample Task, purpose, and rhetorical strategies	Kinds of evidence required	Most prominent textual features called for	Other teacher directives and advice
Lab report	Biology	Report on an experiment. Organize the paper with subheads for review of other experiments (“literature review”), hypothesis, methods, results, and conclusions	Systematic, objective descriptions of methods and results; other researchers’ experiments, results, and conclusions	Place the hypothesis after the review of the literature. Summarize the studies. Paraphrase specific points. Use quotes only rarely.	Use <i>APA style</i> . Leave out personal opinions. Do not use contraction.
Scientific Research Paper	Zoology	Investigate why the Pacific Meadowlark populations are dropping in Northern California. Paper should include Introduction (with hypothesis), Abstract, Review of the Literature, Methodology, Results and Discussion.	Systematic objective descriptions of methods and results. Literature review citing other researchers’ studies, experiments, results and conclusions.	Paper begins with identifying a problem to be investigated. Author has designed and conducted an experiment, made observation or conducted research. Paper is written to inform science community of new findings.	Be concise. Use <i>APA style</i> , <i>Council of Science Editors Style (CSE)</i> , or <i>American Medical Association Manual of Style (AMA)</i> . Leave out personal opinions. Do not use contraction.

Type of writing assignment (genre)	Course/ discipline	Sample Task, purpose, and rhetorical strategies	Kinds of evidence required	Most prominent textual features called for	Other teacher directives and advice
Literary analysis essay	English	Analyze a character in a novel. Explain how the character is developed and why – for example, how the character fits into the plot and theme of the novel.	Character description with details from novel (not opinion); textual examples of the character’s actions, thoughts, relationship to other characters, and so on.	Briefly summarize the plot. Develop a thesis that makes an argument about the character’s role in the context of the theme and plot. Support your points with specific examples and details from the novel. Quotes from the text are expected.	Analyze. Don’t just summarize story passages. Support your interpretations with textual evidence. Avoid personal opinions about your likes and dislikes. Don’t use passive voice. Use present tense. Use <i>MLA style</i> .

APPENDIX C

The Active versus Passive Voice in Writing

In the active voice, the grammatical subject is the doer of the action, and the sentence tells, “who’s doing what.” The passive voice tells what is done to the subject of the sentence. The person or thing doing the action may or may not be mentioned, but is always implied.

Verbs are also said to be either active:

The executive committee approved the new policy.

or passive:

The new policy was approved by the executive committee.

In the active voice, the subject and the verb relationship is straightforward: the grammatical subject is the doer of the action, and the sentence tells, “who’s doing what”. The verb ‘actively’ moves the sentence along.

The passive voice tells what is done to the subject of the sentence. The subject of the sentence is acted upon by some other agent or by something unnamed (The new policy was approved). Computerized grammar checkers can pick out a passive voice construction from miles away and ask you to revise it to a more active construction. There is nothing inherently wrong with the passive voice, but if you can say the same thing in the active mode, do so (see exceptions below). your text will have more pizzazz as a result.

We find an overabundance of the passive voice in sentences created by self-protective business interests, magniloquent educators, and bombastic military writers (who must get weary of this accusation), who use the passive voice to avoid responsibility for actions taken. Thus, “Cigarette ads were designed to appeal especially to children” places the burden on the ads – as opposed to “We designed the cigarette ads to appeal especially to children,” in which “we” accepts responsibility.



At a White House press briefing, we might hear that “The President was advised that certain members of Congress were being audited” rather than “The Head of the Internal Revenue Service advised the President that her agency was auditing certain members of Congress” because the passive construction avoids responsibility for advising and for auditing.



One further caution about the passive voice: **we should not mix active and passive constructions in the same sentence:** “The executive committee approved the new policy, and the calendar for next year’s meetings was revised” should be recast as “The executive committee approved the new policy and revised the calendar for next year’s meeting.”

When to use Active Voice

In general, writing should be composed in the active voice because of the sense of immediacy and conciseness conveyed when the subject of the sentence carries out the action. In addition, fewer words are usually required for the active voice, it is more efficient, and it takes the reader from point A to point B in a “straight line.”

When to use Passive Voice

The passive voice does exist for a reason, however, and its presence is not always to be despised. The passive is particularly useful (even recommended) in two situations:

When it is more important to draw our attention to the person or thing acted upon:

The victim was apparently struck during the early morning hours.

When the actor in the situation is not important:

The aurora borealis can be observed in the early morning hours.

In scientific writing, overuse of passive voice or use of passive voice in long and complicated sentences can cause readers to lose interest or to become confused. Sentences in active voice are generally—though not always—clearer and more direct than those in passive voice.

That being said, the passive voice is especially helpful (and even regarded as mandatory) in scientific or technical writing or lab reports: The actor is not really important but the process or principle being described is of ultimate importance.

Instead of:

“I poured 20 cc of acid into the beaker”

Better to say:

“Twenty cc of acid was poured into the beaker”



The passive voice is also useful when describing, say, a mechanical process in which the details of process are much more important than anyone’s taking responsibility for the action:

“The first coat of primer paint is applied immediately after the acid rinse.”

Thus in scientific writing, the passive voice is often preferred to indicate objective procedures. Scientists and engineers are interested in analyzing data and in performing studies that other researchers can replicate. **The individual doing the experiment is therefore relatively unimportant and usually is not the subject of the sentence.**

The active voice enhances the authority of the writer, while the passive voice can obscure it.

Passive voice: "It is understood by college students that good writing is essential in college."

Active voice: "Students understand that good writing is essential in college."



Consider these pairs of sentences:

The report was read by Betty.
Betty read the report.

A decision was made to stop the project.
We decided to stop the project.

The passive voice should be avoided.
Avoid the passive voice.

Scientists conduct experiments to test hypotheses.
Experiments are conducted by scientists to test hypotheses.

Now, ask yourself: which of the two sentences in each set sounds better to you – and why? In general, the active voice (the second sentence in each pair) is preferable to the passive voice (the first sentence in each pair) because the active voice tends to be simpler, clearer and more direct.

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