From Carla Roberts, Proprietor of Preferred Copy Editing. Email: preferredcopyediting@yahoo.com
Website: www.preferredcopyediting.com

CARLA'S TIPS ON TECHNICAL WRITING

This manual helps answer questions pertaining to the composition of a thesis, dissertation, and/or journal article. The topics are arranged in alphabetical order to help you find answers to your questions quickly. This manual is also written to refresh the memory of accomplished writers and to help those brilliant students who are still struggling with English simply because it is their second language. Whether you need a little help or a lot, I hope you find what you need here. *—Carla*

AVOID "ABOVE, BELOW OR ON THE NEXT PAGE"
--WHEN REFERRING TO TABLES AND FIGURES.

Avoid using words which place your figures or tables in a particular place (above, below, on the next page). Often editors will change format and make corrections which will change the placement of copy. Just make sure you keep your figures and tables close to the copy which refers to them. Also, try not to break a table into two pages. Exceedingly long tables should be put in an appendix.

CAPITALIZATION RULES

Sentence case refers to a capitalization style in which most words other than the first word and proper nouns or acronyms are lowercased.

Title case refers to a capitalization style where the first letter of the first and last word are capitalized as well as all nouns, pronouns, adjectives, verbs, adverbs, and subordinating conjunctions (*If, Because, That, Which*). Capitalize abbreviations that are otherwise lowercase (e.g., use DC, not dc or Dc) except for unit abbreviations. Do not capitalize articles (*a, an, the*) or coordinating conjunctions (*and, but, for, or, nor*). Most short prepositions are lowercase unless they are the first or last word. Prepositions of more than three letters (*before, through, with, without, versus, among, under, between*) should be capitalized.

CAPITALIZATION of the words "Section, Table, and Figure: Capitalize the word Section when referring to a numbered section title. Also capitalize the words Table and Figure when referring to a numbered table or figure.

CODING ARTICLES YOU READ FOR SORTING

Code validating, problematic and contradictory material by inserting the following capital letters or symbols at the beginning and end of the sentence or sentences of interest: **V** for Validating 👍; **P** for Problematic 👎; and **C** for Contradictory ☠. Every student will have some misconceptions going into their adviser-assigned field of research. There will be surprises, disappointments and rewards as the student submits to instruction. I highly recommend that students maintain a daily journal where he or she can record their honest reactions to assignments, experiments and results. Such a record will not only represent the student's journey, but it can also show his or her improvement and transformation from a novice to a highly qualified researcher in the chosen area of study. This should be a personal journal—not shared with anyone. However, be forewarned— writing down one's honest reactions can easily lead to new ideas that the student will be excited to share with others! Material can change from 👎 to 👍 through diligence, discipline, and a willingness to be taught so as to effectively communicate with fellow students and with the adviser.

CODING FOR ATTRIBUTION (ASSURING AVOIDANCE OF PLAGIARISM)

1) **Secure with Quotation Marks. Separate with Space**.
   Secure copied material by inserting the appropriate quotation marks at the beginning and end of the quotation.
   Separate by dropping the quotation down two lines, single spacing that material, and providing a half-inch margin on each side. Put author, date of publication, and page number in parentheses. This is an APA in-text citation. Follow up in the next paragraph with the full reference in brackets.

   > "Insert the appropriate quotation marks at the beginning and end of the
   > material and follow with an in-text citation (Roberts, 2013, p. 2).

   [Roberts, C. (2013). *Carla's Tips on Technical Writing,* internal communication], provided by email on mo/dd/year]. Putting the full reference in brackets during the draft stage gives you the material you need to build your bibliography when the time comes to do so. Further review may lead you to decide that you don't want to use the material for the article you are currently writing—but that it might be something you can use in another article. I recommend copying these quotations and sources in a separate document for future reference and saving that document as "Quotations for Future Research on . . ."

2) **My Summary:** In the draft stage—when paraphrasing or summarizing someone else's information in your own words—you should take the time to code that material prefacing your summary remarks with *My Summary* (Jones, 1995, p. 84). In this case, you are simply rewording what the author has said.

3) **My Thoughts:** When drafting your personal assessment, you should preface your thoughts with the words *My Thoughts*. These are not a rewrite of the author's findings. They reflect your educated opinion of those findings. Sorting symbols (V for Validating 👍; P for Problematic 👎; and C for Contradictory ☠) can be used to verify your reaction. You will not use them in your final draft, but they will help you shape and reshape your convictions concerning other author's work as you become more experienced. In the final version, you can say, "This writer approached the problem from a different perspective . . ." or This author's research results determined that . . ." or "My research team and I found the traditional method problematic because . . . Our new method improved performance time by 50% and was 30% more cost effective."

4) **Identify the speaker and the doer of the research you are presenting**.
   Let the reader know who represents the work being discussed. Do not hide that person's name behind an all-inclusive "we" or an ambiguous bracketed number [4]. See p. 28.

Remember that copying someone else's work and not giving that person credit for their words or graph or table is called plagiarism. It can cause a student to suffer disciplinary probation and even suspension or expulsion from the university.

Commas

No one seems to know what to do with a comma! They are sprinkled liberally throughout most documents like too much pepper on scrambled eggs. The following rules will hopefully help you know when to use a comma and when not to.

COMMAS AND APPOSITIVES

An appositive is a noun or a noun phrase placed next to another noun or noun phrase to define or modify it. An appositive is always set off by commas. Some examples follow:

Nonrestrictive Appositive
Example: Lucky, my favorite childhood dog, loved to accompany me on bike rides.

The nonrestrictive appositive, "my favorite childhood dog," can only refer to Lucky, but it is not essential to the structure of the sentence. The sentence can stand alone without it. If stated as "Lucky loved to accompany me on bike rides;" then, we would still have a structurally sound sentence.

A restrictive appositive is necessary to maintain the meaning of the sentence and does not require commas. Usually, a restrictive appositive is essential to the identity of the preceding word (noun) or words (noun phrase). It "restricts" or narrows the meaning of the word it modifies:

Example 1: The musician Alicia Keys completed a *Set the World on Fire Tour* in December of 2013 in support of her latest album *Girl on Fire* released in late 2012.

"Alicia Keys" restricts the general term "musician," and *Girl on Fire* restricts the general term "album."

Note: Alicia Keys is such a well known musician with such a huge repertoire that the name of her tour and related album are essential to the meaning of the sentence.

Example 2: John Grisham's book *A Time to Kill* is one of the most popular novels of our time.
A *Time to Kill"* restricts the general term "book." Like Keys, Grisham is prolific. He has written several novels and the title (a restrictive appositive) representing "one of the most popular novels of our time" is essential to the meaning of the sentence.

A nonrestrictive appositive must be set off with commas because it is naming the **only possibility.** Grisham and Keys had several possibilities when it came to their creative output. If we are discussing an author' specific contributions to his genre, and they represent his or her only contribution as defined—then those titles are nonrestrictive.
Example 1: "In 1989, Mikel Dunham published his first mystery novel*, Stilled Life*, followed by its 1992 sequel, *Casting for Murder*.

These titles are nonrestrictive and must be set off by commas. *Stilled Life* refers only to his first mystery novel, and *Casting for Murder* refers to the only sequel. The sentence could stand alone without the titles by stating: "In 1989, Mikel Dunham published his first mystery novel followed by its 1992 sequel. The titles are information that most people want to know, but the sentence is structurally sound without them making them nonessential.

Example 2: Dr. Hongbin Ma, director of the MU College of Engineering's Center for Thermal Management, uses nanotechnology to create new ways of cooling electronic devices.
The rather long nonrestrictive appositive refers to Dr. Ma's administrative position. This information is good to know, but it is not essential to the structural soundness of the sentence. It is a

nonessential "nonrestrictive" appositive. It also refers to Dr. Ma's exclusive leadership position. He is the only director of the Thermal Management Center; therefore, the appositive names the **only possibility** for this position and must be set apart with commas.

Remember:
A Nonrestrictive Appositive is nonessential because the sentence makes sense without it; hence, it must be set apart with commas because it represents the only possibility.
The nonrestrictive appositive gives us added information (e.g., the name of a book or the title of an administrator). The added information is always helpful and often important to the meaning of the sentence, but the sentence is structurally sound and makes sense without it.

A Restrictive Appositive represents essential information and is **not** set apart with commas. The sentence would **not** make sense without it.

COMMAS IN NONRESTRICTIVE CLAUSES: Commas **are** used to set off nonrestrictive (*nonessential)* clauses. The sentence would **not** lose its ability to function as a sentence if the nonrestrictive clause or parenthetical phrase were deleted.

Nonrestrictive Clause Example #1: The newly appointed professor asked his department chair, *who has had great success in obtaining research grants,* for advice.
The sentence can stand on its own without the clause (who has had great success in obtaining research grants), which merely adds information.

Nonrestrictive Example #2: Astronomy, *which is the study of heavenly bodies,* is a fascinating subject.
This sentence would still make sense if the clause were removed.

NO COMMAS ALLOWED IN RESTRICTIVE CLAUSES:

Commas are **not** used to set off restrictive (*necessary* or *pointing out*) clauses.

Only students *who have had an article accepted for publication in the proceedings* will have their trip to the conference paid for.

A restrictive (no *commas allowed*) clause says to the reader: Only this particular person or group, object or thing applies to this sentence--and no other." No comma is needed in the above nonrestrictive clause because it refers <u>only</u> to students who have had an article accepted for publication—and no other group. **You cannot extract the clause** (*who have had an article accepted for publication in the proceedings)* **without changing the meaning of the sentence.**

Example: We have decided to hire a graduate research assistant *who is familiar with the project.*

In the above sentence, the italicized restrictive clause says we are hiring a particular kind of student—one who is familiar with the project. No other students should apply—not undergraduates and not graduate students who are unfamiliar with the project. Only graduate students familiar with the project should apply.

RESTRICTING THE FOCUS GENERATES RESTRICTIVE CLAUSES
You usually use "who" or "that" before a restrictive clause. You do **not** use a comma.

Example: Engineering Week organizers ask for posters **that** will spark the interest of visiting high school students.

Only exceptional students can attend conferences **that** offer opportunities for them to win awards based on the quality of their journal articles.

COMMAS BEFORE PARTICIPIAL PHRASES AT THE END OF A SENTENCE
A present participle adds –ing to a verb (e.g., reading, surveying, building).
A past participle adds -ed, -d, -en or -t to the end of a verb (e.g., flipped, taken, said, broken, kept).
This discussion is focusing on the present participles, and our question is:

Should we place a comma before a participial phrase at the end of the sentence?
The answer depends on whether the phrase is restrictive or nonrestrictive!

Nonrestrictive Participial Phrase Example: Powerful winds delayed our experiment, blowing the biomass away from the staging area.

The above sentence can stand on its own without the participle phrase: "Powerful winds delayed our experiment." This means the phrase, *blowing the biomass away . . .,* is nonrestrictive or nonessential, and the information it adds to this sentence must be set off with a comma.

Restrictive Participial Example: A surveillance camera showed the biomass swirling up from the outdoor storage area and across the field.

The participial phrase, *swirling up from the outdoor storage area. . .,* tells us something very specific about what the surveillance camera revealed. This is not extra information. It is essential to the sentence.

COMMAS—TO USE OR NOT TO USE: THAT IS THE QUESTION!
The following is an example about a fictitious restaurant chain to be used only as an example.
The family-owned restaurant chain, Moxie Tamales, is moving forward with plans for two more restaurants in southwestern Missouri. [The name of the restaurant chain is set off with commas. It is a nonrestrictive appositive, which names the chain.]

Notice in the following examples that subjects have a single underline and their verbs have a double underline.

Example of a Compound Sentence: The first restaurant is expected to be operational by 2022, and the second restaurant will begin operation in 2024.

When you take two simple sentences, i.e., independent clauses (which means that each has its own subject and verb) and connect them with the word "and," you have created a compound sentence. The word "and" is always preceded by a comma in a compound sentence.

Example of the Proper Use of a Semicolon: The first new restaurant is expected to be operational by 2022; the second restaurant will begin operation in 2024.

If you leave out the word "and," you can insert a semicolon which takes the place of the word "and" by connecting the two closely related independent clauses. Don't insert a semicolon unless the second sentence has a close easily understood connection to the first sentence.

Example #1-- When a Comma is NOT Needed: The first new restaurant is expected to be operational by 2022 and the second by 2024. –Note the absence of commas here. The verb *is expected* takes care of both restaurants. There is no new subject and verb after *and.*

Example #2-- When a Comma is NOT Needed: The drawing on page two shows the artist's conception of Moxie Tamale's latest new building and includes plans for an outdoor garden/patio area. The subject *drawing* covers the verbs on both sides of *and;* hence, no comma is needed.

COMMUNITY OF RESEARCH

There are numerous ways you can get acquainted with your community of research. If you are a civil engineer, you can join the American Society of Civil Engineers. There's a professional group for every discipline, and each group has a student membership available for a reduced price. Presenting posters about your research at conferences or submitting articles to a conference's call for papers is another way to increase your publication prowess and become known among your peers. The best way to get known, however, is to have articles about your research accepted by peer-reviewed journals. There are literally thousands of them!

Elsevier has 2,721 journal titles which can be accessed by subject area at http://www.elsevier.com/wps/find/journal_browse.cws_home.

Inderscience has 377 journals covering a variety of STEM and business journals. They invite you to browse their topics at http://www.inderscience.com/index.php

Springer publishes 2,600 journals for technical writers to choose from; hence, they have a topic search to help authors find the right journal for submission: http://www.springer.com/authors/journal+authors/helpdesk?SGWID=0-1723213-12-817204-0

Wiley-Blackwell publishes nearly 1,500 peer-reviewed journals. You can browse their subjects and accompanying journal descriptions beginning at http://www.wiley.com/WileyCDA/Section/id-302371.html.

Every discipline has a publisher specifically dedicated to their research.

Automotive engineers have several journals to choose from including a few from Elsevier which include the *Journal of Process Control,* the *International Journal of Process Control,* and the *Mechanism and Machine Theory*. SAGE offers the *Journal of Automobile Engineering* and *Journal of Control Engineering.* Inderscience has the *Int. Journal of Vehicle Design* among others.

Bioengineers often submit to *Cellular and Molecular Bioengineering,* a Biomedical Engineering Society Publication*.* See http://bmes.org/content.asp?contentid=62 for more information about that journal and others. Frontiers in Neuroenergetics has several topics at http://www.frontiersin.org/Neuroenergetics/researchtopics. The key is to read articles by authors you respect in your field and then look at the reference section to see who they submit to. The possibilities are endless.

Civil engineers look to ASCE, which has 32 journals to choose from. See list at http://poc.smartlogic.com/demo_data/ASCE/pubs.asce.org/journals/index.html.
The International Society for Soil Mechanics and Geotechnical Engineering publishes the *Int. J. of Geoengineering Case Histories*, which is devoted to geotechnical engineering, geotechnical earthquake engineering, environmental geotechnics and engineering geology. This represents the first refereed journal devoted to case histories. See http://casehistories.geoengineer.org/

Chemical engineers often rely on the American Chemical Society, which publishes more than 50 journals, lists them at http://pubs.acs.org/action/showPublications?display=journals.

With its publishing partner, Wiley-Blackwell & Sons, AIChE publishes the popular AIChE Journal and three other journals which are listed at http://www.aiche.org/resources/publications/journals .

Computer scientists and computer engineers have the Association for Computing Machinery (ACM), which sponsors a long list of journals at http://www.acm.org/publications/journals.

Electrical and computer engineers have a preference for the Institute of Electrical and Electronics Engineers (IEEE), which has more than 154 journals and hosts 1,200 annual conferences, list their offerings at http://ieeexplore.ieee.org/xpl/periodicals.jsp.

Industrial Engineers look to the Institute of Industrial Engineers, which sponsors seven journals that can be accessed at http://www.iienet2.org/Details.aspx?id=1486.

Mechanical engineers look to the American Society of Mechanical Engineers, which has 26 journals listed at http://journaltool.asme.org/Content/index.cfm for a list.

Nanotechnology engineers can look to ASME's Nanotechology Institute for publications at https://community.asme.org/nanotechnology_institute/w/wiki/4212.publications.aspx.

Nuclear engineering students should consider *Nuclear Engineering and Design* at http://www.journals.elsevier.com/nuclear-engineering-and-design as well as *Nuclear Science and Engineering* at http://www.new.ans.org/pubs/journals/nse/. There's also *Nuclear Technology* at http://www.new.ans.org/pubs/journals/nt/.

Physics students examine publications by the American Institute of Physics, which has 18 journals with links to author instructions at http://journals.aip.org/. Also **a**uthors submitting to Health Physics (HP) and Operational Radiation Safety (ORS) are encouraged to submit manuscripts online through the journal's Web site at http://hpj.edmgr.com**.** *Medical Physics*, aka The International Journal of Medical Physics Research and Practice, has author information at http://medphys.org/NewInstructions.asp.

Astronomy Students have a number of publications to view including Springer's *Planetary Science* at http://www.planetary-science.com/authors/instructions as well as Elsevier's *Astronomy and Computing* at http://www.journals.elsevier.com/astronomy-and-computing/and *Astroparticle Physics* at http://www.journals.elsevier.com/astroparticle-physics/.

The disciplines above represent a broad overview of the various disciplines in most colleges of engineering. Physics and astronomy are also included. However, the first four publishing companies mentioned, Elsevier, Inderscience, Springer, and Wiley-Blackwell cover most scientific disciplines on both a national and international scale. When reading an article that pertains to your research, look at the references to see who has been cited and note the journals those authors represent. Talk to your colleagues about the best place to send your article, and don't be afraid to send an editor an abstract to see if he or she is interested in publishing your article.

E

e.g. vs. i.e.
e.g. is Latin for *exempli gratia*, which means *for example*.
i.e. is Latin for *id est,* which means *that is*, *namely*, or *in other words*.
Both phrases are preceded and followed by a comma when placed in the middle of a sentence.
Parentheses can also be used.

Example: For multi-part figures that are spread over separate pages, the full caption should appear under the first part (a), while captions for the following parts should be labeled, e.g.,
Figure 4.3b, continued. Captions should be complete, i.e., not abbreviated.

Or: For multi-part figures that are spread over separate pages, the full caption should appear under the first part (a), while captions for the following parts should be labeled (e.g., Figure 4.3b, continued). Captions should be complete (i.e., not abbreviated).

et al.
Use *et al.* when three or more names are given, and do not put any punctuation before or after *et.* However, **always** put a period after *al*. More and more style guides are asking the writer to substitute et al. with "and others." Be sure to find out your style guide's preference. I italicized et al. here for emphasis, but most style guides today ask writers **not** to italicize et al. Never use et al. in a reference section! The bibliography is for in-text citations only.

etc. and so on
etc. stands for *et cetera* meaning literally "and so on." I personally don't like the use of etc. anywhere. To me it's like saying blah, blah, blah! I would rather see all options or the most important items listed and the "etc." designation left off.

HYPHENATED MODIFERS:

A hyphenated modifier is a compound adjective or adverb created by hyphenating multiple words that work together as one word describing or modifying the word they precede. Examples: real-world applications, through-the-roof anxiety, over-the-top designs, and word-of-mouth advertising. When using a hyphenated modifier in a title that is set in title case, only capitalize the first word in the hyphenated combination.
Example 1: Missouri Tigers Proved Defenseless Against Tre Mason's 304-yard, **Four-touchdown** Performance in SEC Championship Game.
Example: Heat Transfer Characteristics of the **Jacket-type** Radial Heat Pipe Without Wick

HENCE vs. HOWEVER
Hence is another way of saying "for that reason." It tells us why.
 "Hence" indicates that you have presented a problem or situation which needs an explanation.
Example: My friend is on a gluten-free diet; hence, I will need to explore gluten-free recipes if I am to invite her over for lunch.

Using **however** is another way of saying, "Wait! Slow down! We have a problem."
Example: I invited my friend over for lunch. However, I am worried about not being able to serve the gluten-free menu needed to make sure she stays on her diet.

IN vs. INTO

Into and "**in to**" do not mean the same thing. The word "**Into**" leads us into a movement, action or transformation; however, "**in to**" simply means "in order to." When *in* and *to* are used as separate words, they are not a combined phrase. Here are some examples:

Example #1: I decided to bring my potted plants **in to** protect them from the forecasted frost.

Example #2: I am going **into** town to buy some growing lights, which I hope will keep my plants healthy through the winter.

JOURNAL ARTICLE'S OVERALL STRATEGY

One of the best compilations of rules that this writer has seen on the overall strategy to use when writing a journal article is written by Weixiong Zhang, a professor of computer science and a professor of genetics at Washington University in St. Louis. It can be found in the publications section of his website (http://www.cse.wustl.edu/~zhang/) and is currently cited as:

W. Zhang, **Ten simple rules for writing research papers,** *PLOS Computational Biology*, in press, preprint.

JOURNAL ARTICLE WRITING

The following sections pertain to writing a journal article. However, this same outline can also be used to write your thesis.

JOURNAL ARTICLE'S ABSTRACT
An abstract should always give your peers a reason to read. Abstracts normally have a word limit between 200 and 400 words. A good abstract has five components which answer the following questions in the order presented:
1) *What is the purpose of the work*
   (Why is your work important? Who cares?)
2) *What is the work scope?*
    (What did you set out to do considering the time, budget and facility constraints?)
3) *What procedures or methods did you use?*
   (Methodology)
4) *What are the key findings?*
   (Results)
5) *What is your Conclusion?*
   (Value, Applications, and/or Societal Benefit)

Most editors combine the second and third components, and some would have you choose one or the other. However, I believe they should be addressed separately. The abstract's summation of your methodology is not a step-by-step account. After all, you only have 1-2 sentences to answer each question. You can say you used the Monte Carlo method to achieve your purpose or the Analytic Hierarchy Process decision analysis to compare systems, but in the end, work scope and methodology are separate processes.

When writing an abstract use concise but complete sentences, and get to the point quickly. Use past tense when referring to completed work. Most journals want you to place your abstract in a single paragraph. That paragraph should clearly state the objective, scope, and results so that readers can determine whether the full text will be of particular interest to them. Write your abstract in easy-to-understand language for a general audience—those who have an interest in your field of study, but who are not experts. Do not include jargon, equations, in-text citations or allusions to a figure or table numbers in an abstract.

JOURNAL ARTICLE'S INTRODUCTION

After the abstract (see beginning of this manual), comes the introduction. Here, you introduce your subject and present a condensed literature review.

- ➢ Immediately let your reader know why you are writing this article. For example:
    - ♣ "The rapidly decreasing demand for (what?) is triggering important changes in (what?) " (which your research addresses by doing what?) or
    - ♣ "In this research, we examine . . ., link . . . , and estimate . . . to achieve (what?).
    - ♣ Let the reader know why there is a problem and what you intend to do about it.

- ➢ Explain what makes your research different from your peers.
- ➢ Define your hypothesis.
- ➢ Establish why your research is important?
    - ♣ Does it add a missing piece to a puzzle that needs solving?
    - ♣ Does it address a societal need?

- ➢ Let the reader know what specific void your research fills.
    - ♣ Present the background or context for your paper by establishing the key progress prior to your intervention (mini-literature search featuring only the most important prior research). Show how previous research recognized important variables which laid a foundation for the new research presented.

    - ♣ Show how previous research was limited.

    - ♣ Show how previous research recognized the same problem that you are addressing but did not offer a solution.

    - ♣ Read as many articles about your subject as you can find. Look up the sources listed in those articles. Download articles that pertain to your research for future reference. Highlight and code the paragraphs that pertain to your research. Organize those articles in electronic folders. See section entitled "Organizing Your Thesis.

JOURNAL ARTICLE'S METHODOLOGY

Description should make readers feel as though they could repeat the process themselves if given the chance. The methods section can describe:
- ➢ study site,
- ➢ study design (controls, treatments, variables),
- ➢ protocol for collecting data, and
- ➢ how the data were analyzed (name of method used).
- ➢ If you have developed a new method—name it! Give it a label whereby other researchers can refer to it.

Results:
- ➢ Present results objectively without interpretation
- ➢ Stress the key results which provide answers to the questions investigated
- ➢ Use tables and figures to illustrate results in an orderly and logical sequence
- ➢ Report shortcomings, surprises, and disappointments if applicable.

JOURNAL ARTICLE'S DISCUSSION
1) Do your results provide answers to your testable hypotheses?
   If so, how do you interpret your findings?

2) Do your findings agree with what others have shown? If not, do they suggest an alternative explanation or perhaps an unforeseen design flaw? Answering this question will kick off your more detailed literature review which will:
   ➢ identify a lack of information or inability to solve your chosen research problem,
   ➢ justify the need for more study
   ➢ convince the reader that you know what you are talking about because . . .
       ♣ you are an expert in your field (Don't be afraid to cite your own publications!);
       ♣ you have studied the work of your peers and predecessors (cite their studies);
       ♣ you have tested alternative methods (explain why they are not as effective as your method).

Journal Articles' Literature Review Establishes Foundational Framework
Foundational theories and/or methods help strengthen your research plan and allow you to advance your new theory or method by:

➢ providing the reasoning behind your research.
   Or if the old theories/methods don't work, you can show how your new methodology can create new opportunities **or** provide a new theory that can advance current research.
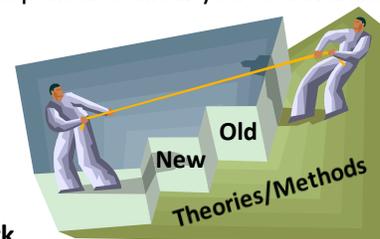
Journal Article's Literature Review Establishes Verifiable Framework
➢ Compares previous interventions and how they apply to your comparatively successful or more successful intervention.
➢ Compares how traditional practices are carried out and why your practice is exceptional.
➢ Explains history of practice. Show how tradition can play a part in a theory or method's continuance even when practicality dictates a new direction.

JOURNAL ARTICLE'S DISCUSSION PERTAINING TO YOUR RESEARCH
➢ Convince the reader that your research plan will provide a verifiable framework for going forward. You've compared your work with others. Make sure your work stands out:
   ♣ Explain advantage of your research and how it could meld with current practices if given an opportunity
   ♣ Identify biases that might be a hindrance to going forward in your field of research.

JOURNAL ARTICLE'S PLANS FOR FUTURE RESEARCH:
Let the reader know what still needs to be done and if you or someone else in your research team plan on making sure the unfinished tasks are completed.

JOURNAL ARTICLE'S CONCLUSION
➢ Ideal opportunity to review the main points
➢ Do not simply repeat (or copy) the information presented in your abstract.
➢ Do emphasize the importance of your work or
➢ Suggest applications and extensions.

JOURNAL ARTICLE'S ACKNOWLEDGMENT
Some journals want the funding agency to be acknowledged in a footnote on the first page with the final Acknowledgment section reserved for collaborators or persons who contributed significantly

with time, in-kind or financial support. Check with journal guidelines to see how the journal you are submitting to wants to handle acknowledgments.

JOURNAL ARTICLE'S APPENDICES
If there is more than one appendix, they should be identified as A, B, etc. Always check author instructions. Appendices may or may not be allowed. If you include tables and figures, be sure to number them beginning with Table 1A and Figure 1A. Do not try to continue the numbering in your main document. Remember that table captions are always placed immediately above the table. Figure captions are always placed immediately below the figure.

Mass Nouns

Most nouns in English are *countable* meaning they have a singular and plural form. Uncountable nouns do not have a plural form. They are inherently plural because they refer to all of something or to a body of information or group of things. Therefore, they do not need an "s." Examples of mass nouns are research, literature, grammar, people, equipment, software, furniture, advice, information, attention, progress, and criticism.

Modifers—Dangling and Misplaced

DANGLING MODIFIERS ARE LEFT WITH NOTHING TO MODIFY.
THEIR COMPANION WORD IS MISSING IN ACTION (MIA):
Conventionally, a participial phrase, prepositional phrase, infinitive phrase, or an appositive phrase modifies the nearest word in the *same* sentence. The same is true for adjectival or adverbial phrases. If that noun appears in an earlier sentence or doesn't appear at all, the reader will become confused. This situation is called a **dangling modifier**. In the case of adverbs, adverbs should modify the nearest verb or the subsequent adverb or adjective in the *same* sentence. If not, it also is a dangling modifier.

When a phrase does not have a companion word to modify—I classify that subject as **missing in action**!

Example 1: Trying to carry too many packages, my I-Phone fell into a puddle of water.
(Was the *I-Phone* trying to carry too many packages?)

Notice that the subject is missing. Who was running for the bus?
Corrected Example: Trying to carry too many packages, **I** dropped my I-Phone, which fell into a puddle of water.

Example 2: After ordering the wrong chemicals, **the experiment** was doomed to failure.

Once again, the subject is missing. In the above sentence, the experiment ordered the wrong chemicals. The prepositional phrase, "After ordering the wrong chemicals, does not have a proper subject to modify. Hence it becomes a dangling modifier. Who ordered the wrong chemicals?

Corrected Example: After ordering the wrong chemicals, **I** realized that the experiment was doomed to failure.

Example 3: When delicately browned and sizzling hot, she called the guests to the table.

Really? While some girls like to be tanned (delicately browned) and consider being called "hot" a compliment, it is not the hostess (she) who is delicately browned and sizzling hot.
Corrected Example*(although not as interesting)*: When **the steak** was delicately browned and sizzling hot, she called the guests to the table.

http://web.cn.edu/kwheeler/gram_dangling_mod.html has an excellent explanation of dangling and misplaced modifiers.

MISPLACED MODIFIERS

A misplaced modifier is a word, phrase, or clause that is improperly separated from the word it modifies or describes. If a phrase describes, renames, or elaborates upon a specific word, good writers do two things.

(1) They place this modifier immediately beside the word it modifies.
(2) They make sure the word being modified actually appears in the sentence!

Example: Complaining loudly, her impatience did not help Mary achieve her task more quickly. The example above suggests that a Mary's **impatience** was complaining loudly. Misplaced modifiers can usually be **corrected** by *moving* the modifier to a more sensible place in the sentence, generally next to the word it modifies.
 Corrected: Complaining loudly, Mary found that her impatience did not help her achieve her task more quickly.

Example: Jason was given a multi-colored neighbor's quilt, also called a crazy quilt because of its haphazard pattern and asymmetrical design.

Hopefully the quilt did not belong to a multi-colored neighbor! Instead, the quilt itself is multi-colored. To rewrite this sentence with the modifier of "quilt" in its correct place, we would say:

Josh was given a multi-colored quilt by a neighbor who said it was a crazy quilt because of its haphazard pattern and asymmetrical design.
Several more examples can be found at http://www.towson.edu/ows/moduledangling.htm.
The most dangerous misplaced one-word modifiers are:
> *almost, even, hardly, just, merely, nearly, only*, and *simply*.

Example 1: I almost burn the beans every time I cook. (This means that although the beans get really dry before I remember to add water, I manage not to burn the beans—although it's always close.)

Example 2: I burn almost every pot of beans I cook. (This means that I seldom cook beans without burning them.)

OXFORD COMMA

The serial or Oxford comma comes right before the conjunction (*and* or *or*) when three or more items are listed in a sentence. For example, "My heart beats true for the red, white, and blue." The American preference keeps the comma before "and." The British preference is to leave it out. Since most technical articles are prepared for American journals, I encourage you to leave it in. In fact, all of the major style guides including the Chicago Manual of Style, the American Psychological Association (APA) Style Guide, and the Modern Language Association (MLA) Style Manual, all say

that the Oxford comma should be retained. Only the Associated Press (AP) has discontinued approval of its use. For a wonderful infographic on this subject, see
http://www.onlineschools.com/in-focus/oxford-comma

Parallel construction:

Parallel ideas are easier to understand when expressed in parallel grammatical forms. Single words should be balanced with single words, phrases with phrases, and clauses with clauses. Notice how the improved "after" sentence utilizes the "consistent" use of participles establishing the parallel connectivity needed for sentence flow.

Before: The agenda for this month's meeting **will include** discussion on buying a new steam chamber or fix the one we have. We **will consider attending** the upcoming ASCE conference, and bids received for the construction of our new lab **will be considered**. We will have to choose the best one."

After: This month's agenda will include discussion on **buying** a new steam chamber or **repairing** the old one, **attending** the February ASCE meeting and **selecting** the best bid for construction of our new lab.

Parallel construction is useful when giving step-by-step instructions. In this case, imperative active verbs give the consistency needed to clarify the methodology behind cashew chicken!
Combine soup, soy sauce, and ginger in 3-1/2 or 4-quart slow cooker.
Stir in chicken tenders, mushrooms, celery, carrots, and water chestnuts**.**
Cover and **cook** on low-heat setting for 6-8 hours or on high-heat setting for 3-4 hours.
Stir cashews in to chicken mixture.

Whether you are in your kitchen, in a lab or at your desk writing out instructions on how to solve a problem, using active verbs with the steps listed in order is an example of parallel construction. Notice that it's not the use of verbs alone that makes this parallel, it's the fact that every verb used is active and in the same imperative tense. Consistency of grammatical form is the key to parallel construction.

Question Mark Mania: He asked, "Is the question mark always an outsider"?

The question mark is almost always placed <u>outside</u> of the ending quotation mark. This holds true for any mark except periods and commas.

What do you think of Edvard Munch 's "The Scream"?

If a question ends with a quoted statement that is not a question, the question mark will go outside the closing quotation mark.

Was it Bill Gates who said, " Be nice to nerds. Chances are you'll end up working with one"?
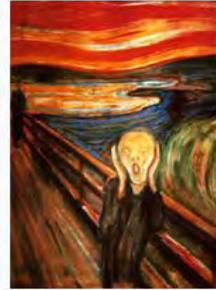
When a Quoted Question Ends a Sentence
If a statement ends in a quoted question, the question mark on the inside of the end quotation mark is all you need to end a sentence.
Example: My daughter once asked, "If a turtle doesn't have a shell, is he homeless or naked?"

When a Question Ends with an Exclamation Mark
If a question ends with a quotation containing an exclamation mark, the exclamation mark will supersede the question and suffice to end the sentence.
Example: Was it Erma Bombeck who said, "In two decades I've lost a total of 789 pounds. I should be hanging from a charm bracelet!"

QUOTATION MARKS:

SINGLE vs. DOUBLE QUOTATION MARKS
Single quotations are used when the quoted material inserts another quotation by someone else. For example, if you wanted to submit an article on the development of the Caterpillar Company, you might write:

A Production Technology article about the inventor, Benjamin Holt, tells us, "Company photographer Charles Clements had observed that the tractor crawled like a caterpillar. Holt responded, 'Caterpillar it is. That's the name for it!' "

Of course you would cite the Production Technology article (http://www.techdirections.com/Holt.pdf). Notice that at the end of the sentence you have a single quotation mark after the exclamation mark followed by a double quotation mark indicating the closure of the complete quotation. A thin space was put between the single and double quotation marks to separate and identify and separate both marks. The easiest way to insert the needed space is to insert the letter "l" instead of a space and then change the font color to white after reducing

the size of that "l" to the size you think looks best. "Holt responded, 'That's the name for it!' "
There is an "l" inserted right after the single quote; it is sized at 4 pt. Calibri and if you change the
color to black, that "l" is barely visible.

COMMAS AND PERIODS *INSIDE* THE END QUOTATION MARK
In American writing, one should place commas and periods *inside* the quotation marks, regardless of
logic. For example: "Marian," mom interrupted, "put that book down and help me in the garden."
This rule applies even when the unit enclosed is at the end of the sentence and consists of just a
single word rather than an actual quotation: Staples tells us to press the button marked, "Easy."

The only ***exception*** to the placement of commas and periods **inside** quotation marks is when that
last item enclosed in quotation marks is one letter or a number, in which case the period or comma
will go *outside* the closing quotation marks: The buried treasure was marked on the map with a
large "X".

Remember though, that the above "X" is in quotation marks. If the last item in the sentence is a
number in brackets, the punctuation goes inside the quotation mark as. The Institute of Electrical
and Electronics Engineers (IEEE) agrees!   The IEEE Editorial Style Manual (IEEE, p. 5) found at
http://www.ieee.org/documents/stylemanual.pdf, states: In-text references should appear in
square brackets, **inside** the punctuation, e.g., "as demonstrated in [3]; according to [4]."

RESPECTIVELY vs. RESPECTIVE

"Respectively" means in the order given; hence, it defines the order of a series. Putting a comma
before "respectively" tells the reader to stop and look at the order of the items just mentioned.
Always put a comma before the word respectively.

Example 1: POLYCAT® 5 and POLYCAT ® 8 were used as the blowing catalyst and gelling catalyst,
respectively.
Example 2: The names of Abraham Lincoln's children were Robert "Bob" Todd Lincoln, Edward
"Eddie" Baker Lincoln, William "Willie" Wallace Lincoln, and Thomas "Tad" Lincoln, respectively.
Here the sons are presented in order of the oldest son to the youngest, and a comma is always
needed when two or more persons, items, processes or events are listed in a specific order.

Example 3: I was introduced to contemporary poets from the sixties according to my teacher's
conception of their precedence. In one semester, I studied Robert Frost with his *snowy woods*,
Theodore Roethke who *learned by going where* he had *to go*, Stanley Kunitz who had saw his dead
father as an *albino walrus* with the *gentlest eyes*, and John Ciardi who spoke of being *locked in* his
father's watch on National Public Radio, respectively.

When respectively is NOT needed:
Bad Example: Kunitz and Roethke both taught at Bennington College in Vermont, ~~respectively~~.

The sentence above illustrates a common error. I put a strike through respectively because
Bennington College is really one unit, there is no comparison being made. For example, if we were
to discuss the respective classes that each man taught, then "respectively" would be necessary to
establish which poet taught which class.

RESPECTIVE means separate or particular and comes before a noun.

Example: The decorated eggs went into their respective gift boxes and were delivered to all the elementary schools in the area.

When respective is NOT needed:
Example: Some say poets Allen Ginsberg and Sylvia Plath were the ~~respective~~ leaders of beat generation poetry and confessional poetry.

Above Example rewritten in such a way that respective is appropriate:
Allen Ginsberg and Sylvia Plath were the respective leaders of two major poetic movements.

Example of above sentence using respectively:
Allen Ginsberg and Sylvia Plath led the way for the beat generation of poetry and confessional poetry, respectively.

Semicolons: Clearing Up Some Confusion

If you want to go from one independent clause to the other **without** inserting "and," you have to use a semicolon instead of a comma to separate the two thoughts. The semicolon signifies the end of a complete thought (one that contains both a subject and verb) and it also tells us that the next complete (independent) thought or clause is closely related to what was just said.

Example:
The most difficult task in a perennial garden is separating the weeds from the flowers; my cone flowers were falsely identified, and yes, I pulled them—a terrible sin. I will miss them.

You will also want to use a semicolon when you want to connect two independent clauses wherein the second clause, i.e., the complete thought with its own subject and verb is preceded by an introductory word like "however" or "for example."
Example:
Learning grammar can be a drawn out and tedious process; however, one cannot claim to be a master of technical writing if they are not willing to master grammar.

Semicolons separate items in a series when they contain items that already contain commas.
Example: We thank Dr. Yadong Li, Jackson State University, for providing test results; Hongbin Ma for providing helpful consultation; and the National Science Foundation for financial support (Grant ABC####).

SI Units (Système Internationale Units)

All technical journals want you to use SI units. **Always put a space between the number and the symbol.** See http://lamar.colostate.edu/~hillger/correct.htm for this rule and other rules concerning correct SI-metric usage. There are several online sources which list these international units and their meanings. Système Internationale (SI) units are the most widely and officially recognized system of metric units. SI units represent the primary system of weights, dimensions, and other physical measures. For more information about SI units, visit the Web sites of the U.S. Metric Association (USMA), Inc. at www.metric.org or the National Institute of Standards and Technology (NIST) or consult the book, Metric Units in Engineering: Going SI. See http://lamar.colostate.edu/~hillger/unit-definitions.html for the official definitions of SI units, including a history of previous definitions. This list also includes some units that are technically not SI units but are used with SI (such as the liter) or that are obsolete (such as the micron).

Splint infinitives

According to modern-day grammarians Mignon Fogarty (Grammar Girl) and Jane Strauss (author of the Blue Book of Grammar and Punctuation), the split infinitive rule is not something to worry about. Fogarty calls it an imaginary rule that was forced into English grammar during the Victorian age because you could not split an infinitive in Latin. Most grammar experts agree that when a sentence flows well—even when an adverb splits or separates "to" from its verb—as when Star Trek fans were told "**to** _**boldly**_ **go** where no one has gone before," it's okay! See http://www.quickanddirtytips.com/education/grammar/split-infinitives?page=all

Subjects and verbs--Without them, you have a Sentence fragment.

A sentence is a word or group of words that express a complete thought.

Example: The University of Texas at San Antonio opened the nation's first college campus bookless library in 2010.

```
University  |  opened  |  library
The|   |of l Texas
           |at  |  San Antonio
```

I am not going to diagram the rest of the sentence here because our emphasis is on the subject (University) and the verb (opened).

The only time you can**not** see the subject in a sentence is when it is the invisible "you."

Examples: Jump at your own risk! Don't push the panic button.
The subject in both sentences is "You." (You) jump at your own risk! Don't (you) push the panic button.   An imperative (command sentence) will always have "you" as the subject. If a vocative (person being addressed) is involved, then that entity would float on a separate line.


Example: Jeremy, clean the lab.

```
        Jeremy

   (You)   |  clean  |  lab
                   |  the
```

A sentence is a word expressing a complete thought. Every sentence has a subject and a predicate. The simple predicate is the sentence's verb. A sentence will not make sense if it is missing a subject nor will it make sense without a verb. The end result of a missing subject or a missing verb is a sentence fragment.

The subject is tells us who or what the sentence is about. It's the part of the sentence about which an assertion is made.   The predicate tells something about the subject. It's the asserting part of the sentence. Notice that Tyrannosaurus Sue is the dinosaur's full name and so, the simple subject is made up of two words instead of one. Normally a single subject will have a one-word simple subject.

Example 1:

Simple Subject   *Simple Predicate*

The amazing **Tyrannosaurus Sue**   is the most complete and largest *tyrannosaurus rex skeleton* ever assembled.

Complete Subject   *Complete Predicate*
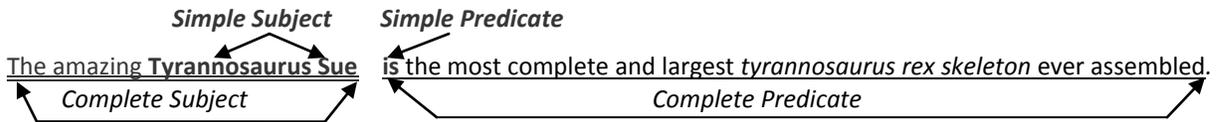
Example 2: The cow jumped over the moon. (In this example, "cow" is the simple subject and "jumped" is the simple predicate. The complete subject has a double underline. The complete predicate has a single underline.

All of this may seem quite elementary. As stated at the beginning of this manual, the writer does not expect anyone to sit down and read the entire manual word for word. Some students are still struggling with the basics of English and need this kind of help. However, sentence fragments are common among everyone. The problem is that researchers are usually under a lot of pressure to write a paper by a certain deadline. They are writing after a long day of teaching or supervising research in their lab or analyzing test results. They don't check their work, and sometimes a sentence fragment will appear. A sentence will simply not make sense. I find this true among American writers as well as international writers. The truth is—we all need proofreaders.
In fact, even proofreaders and copy editors should read their work a second or third time before submitting—after a nice break or preferably—after a good night's sleep.

SUBJECT-VERB AGREEMENT
Basic Rule. The basic rule states that a singular subject takes a singular verb, while a plural subject takes a plural verb.

How can you know whether the subject is singular or plural?
Answer: Verbs do **not** form their plurals by adding an *s* as nouns do.

To determine which verb is singular, ask what ***he*** or ***she*** would say.
To determine what is plural use the word **they**.

Example: **He** *talks* but **They** *talk*
Therefore, *talks* is **singular**, and *talk* is **plural**.

SUBJECT AND VERB—KEEPING THEM TOGETHER
Always try to keep your subject and verb together, and *if possible, please* avoid ending your sentence with a passive verb. The subject has a single underline. The verb has a double underline.

Example: Challenges in sorghum transformation and possible strategies to overcome some of these challenges are discussed.

Corrected Example: This article will address challenges in sorghum transformation and possible strategies to overcome some of these challenges.

To say that this *article* will *address* gives this sentence a more direct (and stronger) approach.
You can also say "The authors will address . . . "

Journals are also accepting the use of "we" and "I," but few actually use "I."
Example 1: We finished at the top of group in the hard template-based human modeling category and third in refinement prediction, finishing overall in the top 15 at the 10th Critical Assessment of Techniques for Protein Structure Prediction competition.

Example 2: The MU College of Engineering protein structure prediction team, MUFOLD, finished at the top of the group in the hard template-based human modeling category . . .

From Carla Roberts, Proprietor of Preferred Copy Editing. Email: preferredcopyediting@yahoo.com
Website: www.preferredcopyediting.com

Giving your team or research project a name once results are ready for publication increases recognition and eliminates the problem of anonymity where team members are hidden behind the all inclusive "we." In a thesis, team members should not only have a team name, but they should be recognized individually. A thesis is about one member's research, but if the other members played a part, they should be given recognition for the part they played in getting the research completed.

SURVEYS AND STATISTICS

CONSORT stands for Consolidated Standards of Reporting Trials, and the CONSORT Statement can help researchers prevent inadequate reporting of randomized controlled trials (RCTs). I highly recommend you go to their website: www.consort-statement.org and view the CONSORT Statement, "which is an evidence-based, minimum set of recommendations for reporting RCTs. It offers a standard way for authors to prepare reports of trial findings, facilitating their complete and transparent reporting, and aiding their critical appraisal and interpretation." (Copied from their website).

The CONSORT Statement consists of a 25-item checklist and a flow diagram. Templates of the CONSORT 2010 checklist are available to download in MS Word and in PDF. Templates of the CONSORT flow diagram are also available in PDF and in MS Word.

Of course, there is a strict protocol that every university follows in regard to contacting participants for a survey and for handling the information you collect. Always contact your university's Research Office or Office of Sponsored Programs and find out what office can help you with your training. At the University of Missouri-Columbia, the Institutional Review Board handles training for everyone who does any kind of research involving human subjects—including preparing surveys.

The most important measure of success for anyone conducting a survey is to have enough participants respond to their survey for credible results. A good answer to the question: "How many survey participants do I need?" can be found at a very user friendly *Science Buddies* site: http://www.sciencebuddies.org/science-fair-projects/project_ideas/Soc_participants.shtml.

If you are preparing a survey in hopes of it providing key information for your thesis or dissertation, make sure you get as much help as possible before creating the survey. Make sure it is approved by your institutional review board and adviser. Most importantly, you should know what is expected from a survey before you begin. Use the CONSORT checklist and flow diagram as a talking point when meeting with your adviser. See how many of the checklist points apply to your research and make sure you can check them off at the end of the project.

SUPERCRIPT NUMBERS—To Use or Not to Use—That is the question!
Like most organizations, IEEE uses superscript numbers for footnotes. If you are going to use the IEEE numbering system for references, use the bracketed numbers. The most commonly recognized style manuals do **not** use numbers in brackets for in-text citations.

Example: Chicago Manual of Style (CMS)
Theodore Roethke once said, "In 20 years of teaching I have become more and more convinced of the desirability of presenting minor writers as one of the principal clues to an age. The 'big' figures would keep coming in repeatedly by way of contrast: they would remain the background against which one plays another music." (Seager 1968)

The American Psychological Association (APA) would cite the above quotation as (Seager, 1968), and the Modern Language Association (MLA)would cite this as (Seager 233-234)

However, the subject here is superscript numbers, and as a general rule, you would **not** put in-text citation numbers in superscript format. However, there is an exception to almost every rule; hence, we see where the American Medical Association (AMA) does use superscript numbers for in-text citations in their articles. I'm sure their other publishers that accept this practice. Therefore, it is important to **ALWAYS check the Authors' Instructions** for any journal you submit to. Find out exactly how they want you to format in-text citations and references <u>before </u>you write your article.

TECHNICAL WRITING is not like writing a mystery novel!

- ➢ Let your reader know what your objective is immediately.
- ➢ Don't hide facts for a surprise ending!
- ➢ Let your heading and subheadings be like mile markers that that assure a safe destination.
- ➢ The best destination is a conclusion, which convinces your readers that the trip was worth the journey.
- ➢ Write short easy-to-understand sentences. Avoid long introductory phrases. Journal editors hate sentences that look like paragraphs!
- ➢ Avoid loading your sentences with prepositions. Strive to make the subject a doer.

Technical writing says what needs to be said quickly and concisely.

> **Incorrect:** *Successful* adoption <u>*of a new research protocol* <u>*for our lab*</u> depends <u>on</u> the leadership <u>of</u> our adviser and the cooperation <u>of </u>participants <u>in</u> following the new procedures.

> **Correct:** We will adopt the new research protocol and follow our adviser's instructions.

The incorrect sentence is cluttered with six unnecessary prepositions. In the corrected sentence, the subject "we" performs the action expressed by its verbs: **_will adopt_** and **_follow_**.

TECHNICAL WRITING IS NOT OBSCURE VERBOSITY—IT IS INFORMATION!

Your readers are in a hurry. They want to extract what they need from your article as quickly as possible so they can continue with their own research. Make sure your abstract has the key words that your audience is looking for. The more you are cited, the quicker your name will be recognized as a person of worth—someone who has important ideas to contribute to their community of research.

Say what you mean and mean what you say. I use Grammar Duck in my seminar series. The following slide shows his disapproval of too many words and not enough action!

Technical Writing Lets the Subject be the Doer and Keeps the Verbs Active

It is not a sin to use passive verbs. In fact, they are preferred when the action is more important than the person or persons implementing that action. However, a sentence is always stronger and more vibrant when the active voice is used. See section in this manuscript entitled "Voice—Active vs. Passive."

A More Precise Sentence: Students will set a professional tone when writing formal papers if they apply the rules of technical writing.

The following discussion on the subject and verb connection was covered on page 19. However, just for fun, I'm sharing another slide from my seminar presentation. I love animation and the disapproving duck and frog are too much fun to ignore.

TECHNICAL WRITING CUTS OUT UNNECESSARY WORDS
Removing passive *to be* verbs usually makes the sentence more concise.
Don't be afraid to perform surgery on your sentences!

He wanted a medication ~~that was~~ prescribed by a physician.
Anyone ~~who is~~ willing to work hard will succeed in this program.

that was   *who is*   *There were*
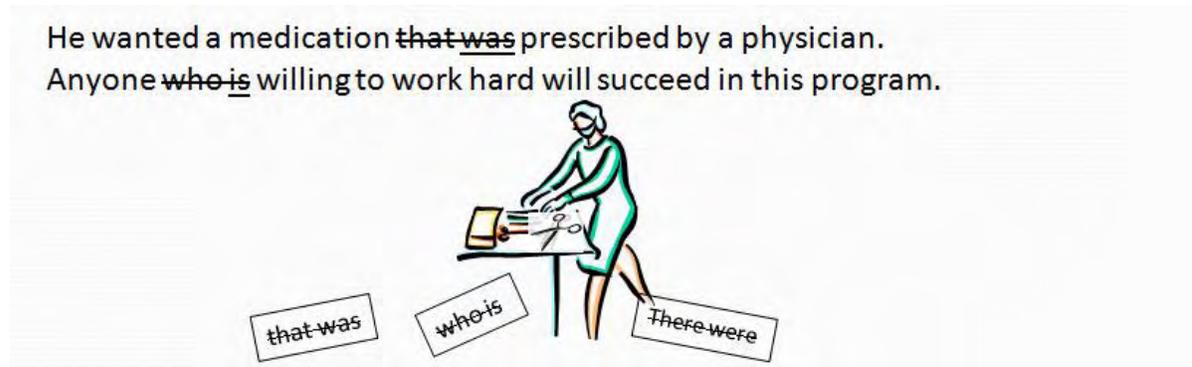
Cutting out Expletive Constructions:
An expletive construction involves "there" and "it" followed by a *to be* verb such as *is, was,* or *were.*

Expletive Example 1: There were some excellent results to this experiment in social work.
Corrected Sentence: The social work experiment produced excellent results.

Expletive Construction Example 2: It was too hot to get any work done.
Corrected Sentence: We could not work in such intense heat.

Notice how giving Example 2 the subject, "we," allows us to follow up with an active verb "could not work," and makes for a more interesting sentence.

TECHNICAL WRITERS MUST CONSIDER THE NEEDS OF THEIR SPECIFIC AUDIENCE
Who are your peers? Will they think your research is important? Can you tell potential readers how your new approach or method it be applied?

➢ Your peers are those who share your interests. Don't be afraid to broaden your interests because the only certainty in research and technology is uncertainty and change. You will undoubtedly be forced to change your course or at least expand your focus numerous times throughout your career.
➢ Study the journals which publish articles relating to your research interests –what you are doing and what you would like to do. They will help you discover who the current experts in your field are and will help you keep up with changes, which are a natural part of the research process.
➢ Always anticipate the question: **So what?** Be prepared to explain why your topic is important.

Does it have intellectual merit? (A National Science Foundation Criteria)
➢ Does it contribute to the body of knowledge sought after by your community of research?
➢ Does it provide a potentially transformative concept? (Will it change the way your peers think about your topic? Will it change the way things are currently done because it offers more efficient or more cost effective methods?
➢ Does it provide a missing piece to a puzzle that needs solving? Does it strengthen a foundational premise?

Does it have broader impacts? (**Another NSF Criteria)**
➢ **Does it have societal value?** Will it help others? How will your new knowledge be applied to solve real-world problems?

> ➢ **Is it commercially viable?** Is it patentable? Can you break down the complexity of your subject to where even a child can grasp the basic concepts behind what you are doing?
> ➢ **Can you get others excited about what you are doing?** Remember that the primary funding agencies for most scientists want you to be able to reach out to K-12 students by creating innovative and exciting experiments, videos, games or any other creative way of catching students' interest. The lack of proficiency in science, technology, engineering and mathematics or what is commonly called the STEM subjects among college-bound American youth has become a national crisis.
> ➢ **Always be thinking about ways to simplify what your explanation so that it can be understood by a 10-year-old!** Remember that those who read your articles are not looking for poetry. They are looking for information, and for many of your readers, English is their second language. They are brilliant researchers from all over the world, but they don't want to have to look up every other word in a dictionary because you are trying to show off your vocabulary.

The National Health Institutes Review Criteria

Remember that all research must be funded. If you are going to have research to write about, you must also learn how to obtain funding. The National Science Foundation (NSF) and National Institutes of Health (NIH) basically want the same thing from their applicants. They want research that solves high priority problems. The following criteria are common among all agencies, but these are specific to NIH:

Significance (aka Intellectual Merit): Does this study address an important problem? If the aims of the application are achieved, how will this advance scientific knowledge?

Approach: Are the conceptual framework, design, methods, and analyses adequately developed, well integrated, and appropriate to the aims of the project? Are leadership roles defined?

Innovation: Does the project employ novel concepts, approaches or methods?

Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies (**the transformative concept**)?

Innovation: Does the project employ novel concepts, approaches or methods? Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies?

Investigators: Are the PD/PI(s) and other key personnel appropriately trained and well suited to carry out this work? Is the work proposed appropriate to the experience level of the PD/PI(s) and other researchers? Do the PD/PI(s) and investigative team bring complementary and integrated expertise to the project (if applicable)?

Environment: Do(es) the scientific environment(s) in which the work will be conducted contribute to the probability of success? Does the proposed study benefit from unique features of the scientific environment or subject populations, of employ useful collaborative arrangements? Is there evidence of institutional support? More information about NIH review criteria can be found at: http://grants.nih.gov/grants/peer_review_process.htm

TECHNICAL WRITING SHOULD BE ABLE TO ESTABLISH A MENTAL FLOW CHART.

Many writers assume their readers know as much as they do about their research! This simply does not make sense. When key information is left out causing the reader to misunderstand a methodology or research process, then the author is doing one of three things: 1) assuming the reader is as much of an expert in this field as he or she is; 2) skipping steps or 3) failing to introduce the process or concept properly by defining related terms. Try creating a mental flow chart. Assume that you are introducing your readers to a subject they know very little about. Pretend you are explaining your research to a student in another discipline or to a friend. In effect, you are giving your friend a guided tour--only it's through the written word. Once introduce the material, then you can slip into the more technical details. If you can produce a mental flow chart—you increase both understanding and readability. Follow these five steps to create your tour:

1. Define the terms needed to understand the process in your introduction.
2. Show how you handle each step in your process in the order of its occurrence.
3. Enumerate the steps
4. Use language that is understandable to anyone from the undergraduate level on up.
5. Use lots of figures and tables to illustrate your points.

It is not good enough for you to believe in the value of your research. Your research community must also see its value. Be sure to ask yourself what research community you want to align yourself with. What are you really interested in?

You also want to consider how the reviewers of your future journal articles, conference presentations and proposals are going to receive your ideas. Will they take you seriously? Will they try to contradict your findings?

TIMELINES AND GANTT CHARTS

Every funding agency wants to know what you are going to do and when you are going to get it done. A two-year research project should have quarterly goals and these goals should be easy to follow and illustrated in a Gantt chart or timeline. There are free PowerPoint templates (http://officetimeline.com/) and in Excel (http://www.vertex42.com/ExcelTemplates/excel-gantt-chart.html). A brief and easy-to-follow article on using Excel to create a Gannt chart can be found at http://office.microsoft.com/en-us/excel-help/create-a-gantt-chart-in-excel-HA001034605.aspx.

The following Gantt chart was prepared in Word. It is a very simple chart prepared for this manual, but it gives you a basic idea of what is needed. The same chart can be copied and pasted for Year 2 with the required new information put in the spaces.

Timeline for Year 1

Year 1: Tasks	Jan.-Mar.	Apr.-Jun.	July-Sept.	Oct.-Dec.
Literature Search, Consortium Planning Sessions	▓▓▓			
Preliminary Tests and Analysis of Results		▓▓▓		
Data Management Plan and Final Tests			▓▓▓	
Analysis or 1st Year Test Results;				▓▓▓
Preparation and submission of 1st Year Report				▓▓

TOPIC SENTENCES AND THE PARAGRAPH THEY INTRODUCE

The first sentence of your paragraph is a topic sentence, and it represents the central idea of that paragraph. Technical articles are complex and tedious to most readers. Never assume that someone has read every word preceding the paragraph they zero in on looking for specific information pertaining to their particular interest. Every paragraph should encapsulate an idea that can stand on its own. Do not begin a topic sentence with a pronoun. Completely identify the subject.

Other types of writing can weave the primary thought of a sentence into the writing and still make it stand out as the main idea or topic of the sentence. Technical writing cannot be that sneaky! Say what you want to say up front and build on that thought until you are ready for the next concept (e.g., the next paragraph) that needs developing.

Topic Sentence Success: A precise concise topic sentence makes a definite assertion or asks a direct question. It contains the key words that give the topic its substance and clearly states the value of the topic. Do not make the reader guess your intention.

Coherence: Make sure that your supporting sentences back up and develop the central idea in your topic sentence by providing the needed details. Ask yourself, "Does this sentence do anything to clarify the topic and move my thoughts on the subject forward? If it does not, cross it out or move in to another supplementary information document in case it can be developed into another paragraph. Each sentence should lead naturally to the next. That is what editors call coherence.

Emphasis: Your concluding sentence should summarize your topic sentence. Let the reader know the primary fact you want him or her to remember in this paragraph.

THESIS ORGANIZATION
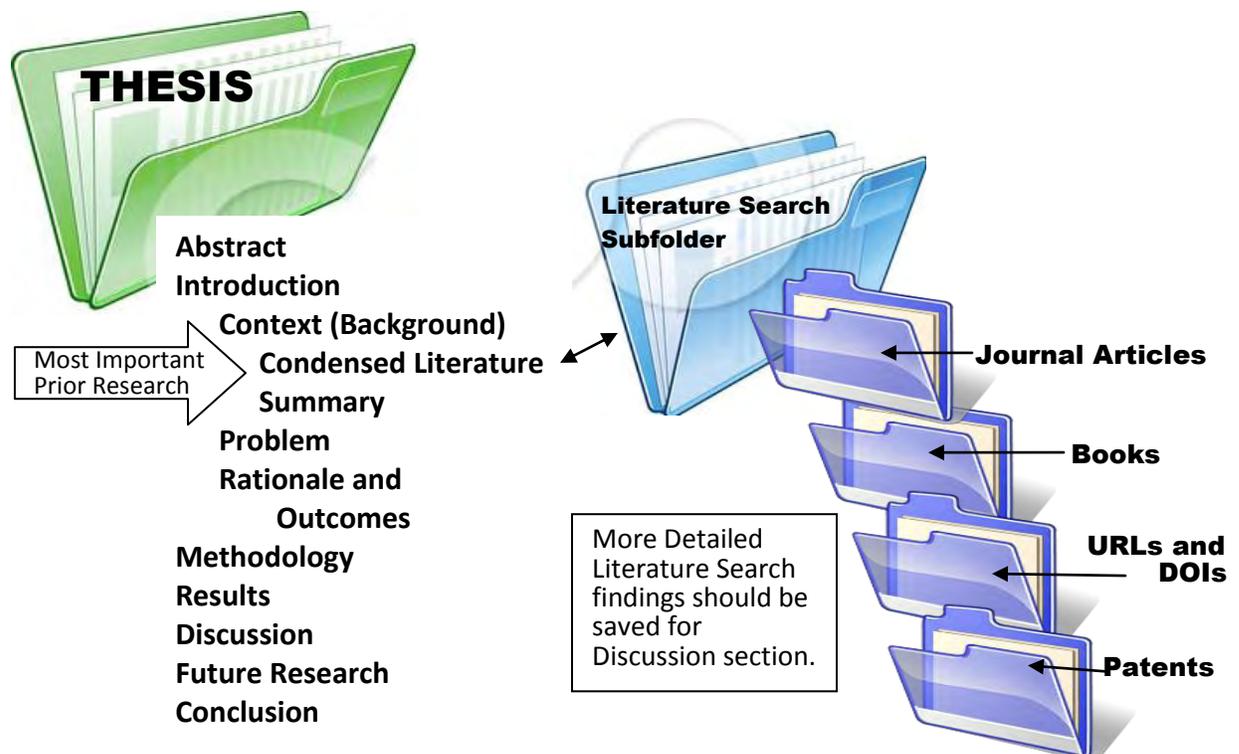
Organizing what your read and what you write can easily be done through the use of electronic folders. You can't summarize your work until you have finished it! You have to be able to step back

after you have organized all of your thoughts and findings into sections. The sections are ordered above according to their appearance in your manuscript; hence the abstract folder is the first folder under the primary thesis folder. However, the abstract will be the last item you complete. It will undergo many revisions before it can be put into its final form.

The Literature subfolder can feed your thesis or article throughout your studies. You should put everything that pertains to prior research in these folders. You will not necessarily use everything you save, but having instant access to something that wasn't all that important when you first looked at it—but suddenly becomes very important toward the end of your study—will save you a lot of time.

The introduction tells the reader why your research is important. It will also explain what others have done to solve the problem or problems you are studying. That information is shown above as your condensed literature summary. The illustration focuses on the importance of the literature search. The discussion section will include more detailed findings from your literature search. If you are coming in as a team member on a research project that has been years in the making, and your thesis is covering the progress to be made during your time as a graduate student, then you need to research the history of your project, its motivation and accomplishments. More importantly, you need to define your role in the project and find out early what your adviser's expectations are.

Every journal article is divided into sections. Those same sections are in your thesis—only your thesis will go into more detail as you expand your research and make sure your efforts are worthy of the degree you are seeking.

THE TILDE—TO USE OR NOT TO USE
APA rules tell us to: Use tilde (~) to mean *approximately equal to.* It is used by some to indicate a range of numbers, but it is not used for this purpose in most American journals. I advise against using it for this reason.

TOO MANY "OFs" IN THE SAME SENTENCE: The word "of" is a reader's speed bump. When used too many times, it distracts from the flow of thought. Try to put the object or item that "of" refers to in a possessive position whenever possible to avoid overusing "of."

Example: This is an example **of** a case **of** overusing the word **of** wherein the tools **of** my neighbor became a point of contention due to his continual habit **of** leaving them to rust in various locations **of** our shared property.
Instead: The following rewrite completely eliminates the word *of*: My neighbor's tools became a problem due to his insistence on scattering them throughout our shared property and leaving them to rust.

TOO MANY *THEs:* The (specific) word "the" should only be used when referring to one particular or "specific" activity, process, unit, item, experience, instance or event. If you can put "specific," "one-of-a-kind," "special," "particular," or "only" in front of a word, then use "the." If you are referring to a brand name or procedure named after a person or organization, then you would use "the."
If you are referring to "all," "several," or "any" when describing a noun, then do **not** use "the."

USING A DASH TO GIVE THE READER A CAUSE TO PAUSE
A dash tells the reader to stop—think about what has been said and then go on to concentrate on the material that follows. The dash can also be used to set apart an important piece of information or a series of items which require special attention. For example: In a recent report, Zhang et al.,

(2009) utilized *Agrobacterium*-mediated transformation to transfer *CryIAb* genes into three sorghum cultivars—115, ICS21B and 5-27—with average transformation efficiency of 1.9%.

USING THE PRESENT TENSE WHEN REFERRING TO TABLES, FIGURES, AND SECTION SUMMARIES: Always use the active voice when referring to figures. A figure or table is a new presentation to every reader, which always makes it a present tense occurrence. A figure or table can easily serve as the subject of a sentence and, as such, it can use an active verb to introduce its material. An excellent guide entitled "Writing as Engineers," prepared by the Texas A&M Writing Lab, http://www.tamug.edu/writing/Engineering/Eng%20Handbook1.htm states:
 "When a reference to the table or figure is the subject of the sentence, use a verb like "shows" or "compares" to describe how the figure or table works."

V<small>OICE</small>—A<small>CTIVE VS.</small> P<small>ASSIVE</small>

In a sentence that utilizes the active voice, the subject performs the action.

Example 1: Fire destroyed the storage building; **Example 2:** The assistant mailed the letter.

A sentence using the passive voice shows the subject being acted upon. The passive voice is often used in scientific writing and is not only acceptable but unavoidable when the action is more important than the actor.

Example 1: Prototypes were designed with an emphasis on portability and cost efficiency.
Example 2: The device was built on a glass substrate with gold electrodes.
The passive voice is often used when the actor is unknown, unimportant, or in some instances, in need of anonymity for protection.
Example 1: Mistakes were made. (This protects the persons responsible for the mistakes.)
Example 2: Area schools were closed due to the snow. (The names of the administrators who announced the closings are not relevant. Furthermore, since this is past tense, the urgency in knowing what schools were closed is gone.)

W<small>E</small> – A<small>NONYMITY</small> <small>ENSURED</small>

Students writing their thesis or dissertation often use "we" to describe the teamwork behind their research. The word "we" can cover a multitude of accomplishments and also give anonymous credit to a group when, in fact, the work discussed is one person's work. The person who did the work should get the credit. This editor likes to see a student researcher use his or her name when referring to project achievements. Claiming responsibility for the work presented is not a sin. If your last name is Liu, you can say: Liu found that . . ., and then cite an article or report you wrote where the work you did is discussed or featured. If you have written or co-authored a journal article, that article should definitely be cited in your thesis or dissertation. You can also cite an internal report that you have provided to your adviser as part of the research team. If you are a new postdoctoral research instructor writing a journal article, you can cite your dissertation as well as journal articles and papers you contributed to conference proceedings. I personally cringe when I see researchers hide their identity behind the anonymous "we." I would like to see each person's work cited according to their role in the research. (It's even more offensive to see an author's name sacrificed to a horrendous number enclosed in brackets as in: "Unfortunately, [4] found that no one knew who he was or cared to look him up when his only identity in the narrative appeared as a number!"

A journal article identifies the researchers as the authors. However, in a thesis—if you consistently give credit for every task to a "team" whose identity and roles have not been identified, you can easily sacrifice your identity and your role in the research presented. When writing a thesis—your role is the most important role. You are receiving a MS or PhD based on **your** research, not the research of a collective team.

WIDOWS AND ORPHANS

Widow: You will often see where a paragraph extends to the next page. The paragraph's last line goes forward to the beginning of the following page or column and is separated or "widowed" from the rest of its text. This separation is called a widow. Like a widow in the true sense of the word, it continues to support its family (the paragraph) and completes the paragraph's work after the separation.
Orphan: When the first line of a new paragraph heading appears by itself at the bottom of a page or column—then that is called an orphan. A word, part of a word, or a very short line which is separated from the rest of the paragraph it is related to is called an orphan. The orphan then is left behind until you move it to the next page so it can join its related text.
Orphans are always at the bottom of the page. Widows are always at the top of the next page.

WRITER'S BLOCK AND THE FIVE Ws

As a former TV and newspaper reporter as well as a student at the MU School of Journalism, I was taught early in my writing career to ask the five Ws—who, what, why, when, where—as well as how. A good researcher is designated as the principal investigator of funded projects. Every good investigator knows how to ask questions and find the answers. My answer to the writer's block dilemma can be summarized by a question: Have you asked all the questions that can be asked pertaining to the topic you are pursuing? Assume the role of an investigative reporter by answering:

- **Who** established the foundational theories of my research?
- **Who** are the experts?
- **Who** is my competition—those seeking to accomplish the same mission with different methods?
- **What** are they doing?
- **What** am I doing that's different?
- **What** do I need to advance my research—equipment, facilities, support?
- **What** am I bringing to my research community that is new or valuable or potentially transformative?
- **When** will my project begin and? Have I set a timeline for the completion of my project?
- **When** will I finalize my research plan?
- **When** will you accomplish my next goal?
- **Where** am I going to get funding?
- **Why** is my research important?
- **Why** are my methods better than others?
- **What** journals will I review this week as I perfect my literature search?