

Chapter 1 : Parts of a Research Paper

What is the structure of a scientific paper? All scientific papers have the same general format. They are divided into distinct sections and each section contains a specific type of information.

Format for the paper Edit your paper! A standard format is used for these articles, in which the author presents the research in an orderly, logical manner. The title should be appropriate for the intended audience. The title usually describes the subject matter of the article: "Effect of Smoking on Academic Performance" Sometimes a title that summarizes the results is more effective: "The person who did the work and wrote the paper is generally listed as the first author of a research paper. For published articles, other people who made substantial contributions to the work are also listed as authors. Such abstracts may also be published separately in bibliographical sources, such as Biological Abstracts. They allow other scientists to quickly scan the large scientific literature, and decide which articles they want to read in depth. Your abstract should be one paragraph, of words, which summarizes the purpose, methods, results and conclusions of the paper. It is not easy to include all this information in just a few words. Start by writing a summary that includes whatever you think is important, and then gradually prune it down to size by removing unnecessary words, while still retaining the necessary concepts. It should be able to stand alone without any footnotes. Why is it interesting? The introduction summarizes the relevant literature so that the reader will understand why you were interested in the question you asked. One to four paragraphs should be enough. End with a sentence explaining the specific question you asked in this experiment. How did you answer this question? There should be enough information here to allow another scientist to repeat your experiment. Look at other papers that have been published in your field to get some idea of what is included in this section. If you had a complicated protocol, it may helpful to include a diagram, table or flowchart to explain the methods you used. Do not put results in this section. You may, however, include preliminary results that were used to design the main experiment that you are reporting on. Mention relevant ethical considerations. If you used human subjects, did they consent to participate. If you used animals, what measures did you take to minimize pain? Use graphs and tables if appropriate, but also summarize your main findings in the text. Do NOT discuss the results or speculate as to why something happened; that goes in the Discussion. Use appropriate methods of showing data. For graphs, you should also label the x and y axes. If you can summarize the information in one sentence, then a table or graph is not necessary. How do these results relate to the original question? Do the data support your hypothesis? Are your results consistent with what other investigators have reported? If your results were unexpected, try to explain why. Is there another way to interpret your results? What further research would be necessary to answer the questions raised by your results? How do your results fit into the big picture? End with a one-sentence summary of your conclusion, emphasizing why it is relevant. You can thank those who either helped with the experiments, or made other important contributions, such as discussing the protocol, commenting on the manuscript, or buying you pizza. Here is one commonly used way: In the text, cite the literature in the appropriate places: Scarlet thought that the gene was present only in yeast, but it has since been identified in the platypus Indigo and Mauve, and wombat Magenta, et al. In the References section list citations in alphabetical order. Queer place for qwerty: Widelicious Wombats, Violet, Q. Isolation of qwerty gene from S. Journal of Unusual Results 36, Write accurately Scientific writing must be accurate. A student who tried not to repeat the word "hamster" produced this confusing sentence: The rats were injected with the drug. I injected the drug into the rat. Be careful with commonly confused words: Temperature has an effect on the reaction. Temperature affects the reaction. I used solutions in various concentrations. The erythrocytes that are in the blood contain hemoglobin. Use the active voice. An increased appetite was manifested by the rats and an increase in body weight was measured. The rats ate more and gained weight. Use the first person. It is thought Write: I think Instead of: The samples were analyzed Write: I analyzed the samples 4. Use verbs instead of abstract nouns Instead of: Use strong verbs instead of "to be" Instead of: The enzyme was found to be the active agent in catalyzing Other surgeons tie them, and it stops the bleeding just as well.

Chapter 2 : WRITING A SCIENTIFIC RESEARCH ARTICLE

The scientific format may seem confusing for the beginning science writer due to its rigid structure which is so different from writing in the humanities. One reason for using this format is that it is a means of efficiently communicating scientific findings to the broad community of scientists in a uniform manner.

This article has been cited by other articles in PMC. Abstracts of scientific papers are sometimes poorly written, often lack important information, and occasionally convey a biased picture. This paper provides detailed suggestions, with examples, for writing the background, methods, results, and conclusions sections of a good abstract. The primary target of this paper is the young researcher; however, authors with all levels of experience may find useful ideas in the paper. Earlier articles offered suggestions on how to write a good case report,[1] and how to read, write, or review a paper on randomized controlled trials. Although the primary target of this paper is the young researcher, it is likely that authors with all levels of experience will find at least a few ideas that may be useful in their future efforts. The abstract of a paper is the only part of the paper that is published in conference proceedings. The abstract is the only part of the paper that a potential referee sees when he is invited by an editor to review a manuscript. The abstract is the only part of the paper that readers see when they search through electronic databases such as PubMed. Finally, most readers will acknowledge, with a chuckle, that when they leaf through the hard copy of a journal, they look at only the titles of the contained papers. If a title interests them, they glance through the abstract of that paper. Only a dedicated reader will peruse the contents of the paper, and then, most often only the introduction and discussion sections. Only a reader with a very specific interest in the subject of the paper, and a need to understand it thoroughly, will read the entire paper. Thus, for the vast majority of readers, the paper does not exist beyond its abstract. For the referees, and the few readers who wish to read beyond the abstract, the abstract sets the tone for the rest of the paper. It is therefore the duty of the author to ensure that the abstract is properly representative of the entire paper. For this, the abstract must have some general qualities. These are listed in Table 1. The usual sections defined in a structured abstract are the Background, Methods, Results, and Conclusions; other headings with similar meanings may be used eg, Introduction in place of Background or Findings in place of Results. Some journals include additional sections, such as Objectives between Background and Methods and Limitations at the end of the abstract. In the rest of this paper, issues related to the contents of each section will be examined in turn.

Background This section should be the shortest part of the abstract and should very briefly outline the following information: What is already known about the subject, related to the paper in question What is not known about the subject and hence what the study intended to examine or what the paper seeks to present In most cases, the background can be framed in just 2-3 sentences, with each sentence describing a different aspect of the information referred to above; sometimes, even a single sentence may suffice. The purpose of the background, as the word itself indicates, is to provide the reader with a background to the study, and hence to smoothly lead into a description of the methods employed in the investigation. Some authors publish papers the abstracts of which contain a lengthy background section. There are some situations, perhaps, where this may be justified. In most cases, however, a longer background section means that less space remains for the presentation of the results. This is unfortunate because the reader is interested in the paper because of its findings, and not because of its background. A wide variety of acceptably composed backgrounds is provided in Table 2 ; most of these have been adapted from actual papers. Note that, in the interest of brevity, unnecessary content is avoided.

Table 2 Open in a separate window

Methods The methods section is usually the second-longest section in the abstract. It should contain enough information to enable the reader to understand what was done, and how. **Table 3** lists important questions to which the methods section should provide brief answers. **Table 3** Open in a separate window

Carelessly written methods sections lack information about important issues such as sample size, numbers of patients in different groups, doses of medications, and duration of the study. Readers have only to flip through the pages of a randomly selected journal to realize how common such carelessness is. **Table 4** presents examples of the contents of accept-ably written methods sections, modified from actual publications. **Table 4**

Open in a separate window Results The results section is the most important part of the abstract and nothing should compromise its range and quality. This is because readers who peruse an abstract do so to learn about the findings of the study. The results section should therefore be the longest part of the abstract and should contain as much detail about the findings as the journal word count permits. Examples of acceptably written abstracts are presented in Table 6 ; one of these has been modified from an actual publication.

Chapter 3 : Example of a Research Paper

Structure of a Scientific Paper Made Easy Scientific publications are an indispensable part of a scientist's life. Sharing one's research findings with the world is an exciting and enriching experience.

Choosing a topic and finding articles What questions to answer in your review Which sections to include and tips for writing them Other tips and tricks are featured underneath this box. It is a quick, easy read that will help you find your footing as you begin! A note on reviews Reviews are usually published by experts in the field. Being familiar with the structure and purpose of reviews will help you navigate scientific literature more confidently, but remember that it is not likely you will be writing a review for publication in a journal until well into your career. Sometimes, journal editors will invite scientists to write a review for their journal. Choose a topic that is not too broad and not too narrow for the type of review you would like to write. If you want to write a shorter review, pick a narrower topic. You want to contribute to the knowledge base and understanding of other scientists so make sure it centers around a topic that has a good-sized audience!

Information to Consider in Your Review: What to Write About When doing research for your review, here is a list of questions to consider as you read through articles to potentially include: Is there a better way to answer the research question? How does the author approach the study - from a theoretical, experimental, interpretive, or clinical etc. Did they choose the best approach? Is the author using an assumed theoretical framework such as, for example, psychoanalytic or developmental? How does this affect the conclusions they draw? How does the author engage with other literature in the field? Did the researchers choose appropriate methods of experimentation and data analysis for the research question? Do you think that the conclusions they draw based upon the data they present are valid and reasonable? Or are there gaps in the logic or assumptions being made? Is it worth including in your discussion, and does it fit your main thesis?

Chapter 4 : Sections of a Paper: Structure of a Scientific Paper

How to Write a Good Scientific Paper: Structure and Organization Writing is inherently a creative process. That would seem a good fit for the science researcher, where creativity coupled.

How to Write an Abstract The first sentence of an abstract should clearly introduce the topic of the paper so that readers can relate it to other work they are familiar with. However, an analysis of abstracts across a range of fields show that few follow this advice, nor do they take the opportunity to summarize previous work in their second sentence. To solve this problem, we describe a technique that structures the entire abstract around a set of six sentences, each of which has a specific role, so that by the end of the first four sentences you have introduced the idea fully. This structure then allows you to use the fifth sentence to elaborate a little on the research, explain how it works, and talk about the various ways that you have applied it, for example to teach generations of new graduate students how to write clearly. This technique is helpful because it clarifies your thinking and leads to a final sentence that summarizes why your research matters. So I should offer a little more constructive help for anyone still puzzling what the above really means. It comes from my standard advice for planning a PhD thesis but probably works just as well for scientific papers, essays, etc. The six sentences are: Phrase it in a way that your reader will understand. Same advice works for scientific papers – the readers are the peer reviewers, and eventually others in your field interested in your research, so again they know the background work, but want to know specifically what topic your paper covers. State the problem you tackle. Again, in one sentence. Keep working at this step until you have a single, concise and understandable question. Summarize in one sentence why nobody else has adequately answered the research question yet. Here you have to boil that down to one sentence. Again for a more general essay, you might want to adapt this slightly: In one sentence, how did you go about doing the research that follows from your big idea. Did you run experiments? Build a piece of software? Carry out case studies? So feel free to omit detail! For those of you who got this far and are still insisting on writing an essay rather than signing up for a PhD, this sentence is really an elaboration of sentence 4 – “explore the consequences of your new perspective. Why should other people care? What can they do with your research. The abstract I started with summarizes my approach to abstract writing as an abstract. But I suspect I might have been trying to be too clever.

Chapter 5 : Scientific literature - Wikipedia

The task of writing a scientific paper and submitting it to a journal for publication is a time-consuming and often daunting task. 3,4 Barriers to effective writing include lack of experience, poor writing habits, writing anxiety, unfamiliarity with the requirements of scholarly writing, lack of confidence in writing ability, fear of failure.

Importance of a Good Discussion The discussion section is often considered the most important part of your research paper because this is where you: If appropriate, the discussion section is also where you state how the findings from your study revealed new gaps in the literature that had not been previously exposed or adequately described, and Engage the reader in thinking critically about issues based upon an evidence-based interpretation of findings; it is not governed strictly by objective reporting of information. **San Francisco Edit, Structure and Writing Style** These are the general rules you should adopt when composing your discussion of the results: Do not be verbose or repetitive Be concise and make your points clearly Avoid using jargon Follow a logical stream of thought; in general, interpret and discuss the significance of your findings in the same sequence you described them in your results section [a notable exception is to begin by highlighting an unexpected result or finding] Use the present verb tense, especially for established facts; however, refer to specific works or prior studies in the past tense If needed, use subheadings to help organize your discussion or to categorize your interpretations into themes **II. The Content** The content of the discussion section of your paper most often includes: If appropriate, note any unusual or unanticipated patterns or trends that emerged from your results and explain their meaning in relation to the research problem. References to previous research: This can include re-visiting key sources already cited in your literature review section, or, save them to cite later in the discussion section if they are more important to compare with your results instead of being a part of the general literature review of research used to provide context and background information. Note that you can make this decision to highlight specific studies after you have begun writing the discussion section. For example, describing lessons learned, proposing recommendations that can help improve a situation, or highlighting best practices. This can be framed as new research questions that emerged as a result of your analysis. **Organization and Structure** Keep the following sequential points in mind as you organize and write the discussion section of your paper: Think of your discussion as an inverted pyramid. Organize the discussion from the general to the specific, linking your findings to the literature, then to theory, then to practice [if appropriate]. Use the same key terms, narrative style, and verb tense [present] that you used when when describing the research problem in your introduction. Begin by briefly re-stating the research problem you were investigating and answer all of the research questions underpinning the problem that you posed in the introduction. Describe the patterns, principles, and relationships shown by each major findings and place them in proper perspective. The sequence of this information is important; first state the answer, then the relevant results, then cite the work of others. If appropriate, refer the reader to a figure or table to help enhance the interpretation of the data [either within the text or as an appendix]. This part of the discussion should begin with a description of any unanticipated findings, followed by a brief interpretation as to why you believe it appeared and, if necessary, its possible significance in relation to the overall study. If more than one unexpected finding emerged during the study, describe each of them in the order they appeared as you gathered or analyzed the data. As noted, the exception to discussing findings in the same order you described them in the results section would be to begin by highlighting the implications of a particularly unexpected or significant finding that emerged from the study, followed by a discussion of the remaining findings. Before concluding the discussion, identify potential limitations and weaknesses if you do not plan to do so in the conclusion of the paper. Comment on their relative importance in relation to your overall interpretation of the results and, if necessary, note how they may affect the validity of your findings. Avoid using an apologetic tone; however, be honest and self-critical [e. The discussion section should end with a concise summary of the principal implications of the findings regardless of significance. Give a brief explanation about why you believe the findings and conclusions of your study are important and how they support broader knowledge or understanding of the research problem. This can be followed by any recommendations for further research.

However, do not offer recommendations which could have been easily addressed within the study. This would demonstrate to the reader that you have inadequately examined and interpreted the data. Overall Objectives The objectives of your discussion section should include the following: You should write a direct, declarative, and succinct proclamation of the study results, usually in one paragraph. Explain the Meaning of the Findings and Why They are Important Consider the likelihood that no one has thought as long and hard about your study as you have. Systematically explain the underlying meaning of your findings and state why you believe they are significant. If applicable, begin this part of the section by repeating what you consider to be your most significant or unanticipated finding first, then systematically review each finding. Otherwise, follow the general order you reported the findings in the results section. Relate the Findings to Similar Studies No study in the social sciences is so novel or possesses such a restricted focus that it has absolutely no relation to previously published research. The discussion section should relate your results to those found in other studies, particularly if questions raised from prior studies served as the motivation for your research. This is important because comparing and contrasting the findings of other studies helps to support the overall importance of your results and it highlights how and in what ways your study differs from other research about the topic. Note that any significant or unanticipated finding is often because there was no prior research to indicate the finding could occur. If there is prior research to indicate this, you need to explain why it was significant or unanticipated. Consider Alternative Explanations of the Findings It is important to remember that the purpose of research in the social sciences is to discover and not to prove. When writing the discussion section, you should carefully consider all possible explanations for the study results, rather than just those that fit your hypothesis or prior assumptions and biases. This is especially important when describing the discovery of significant or unanticipated findings. Note any unanswered questions or issues your study did not address and describe the generalizability of your results to other situations. If a limitation is applicable to the method chosen to gather information, then describe in detail the problems you encountered and why. Make Suggestions for Further Research You may choose to conclude the discussion section by making suggestions for further research [this can be done in the overall conclusion of your paper]. Although your study may offer important insights about the research problem, this is where you can address other questions related to the problem that remain unanswered or highlight previously hidden questions that were revealed as a result of conducting your research. You should frame your suggestions by linking the need for further research to the limitations of your study [e. Besides the literature review section, the preponderance of references to sources is usually found in the discussion section. A few historical references may be helpful for perspective, but most of the references should be relatively recent and included to aid in the interpretation of your results or used to link to similar studies. Problems to Avoid Do not waste time restating your results. Should you need to remind the reader of a finding to be discussed, use "bridge sentences" that relate the result to the interpretation. An example would be: Recommendations for further research can be included in either the discussion or conclusion of your paper, but do not repeat your recommendations in the both sections. Think about the overall narrative flow of your paper to determine where best to locate this information. However, if your findings raise a lot of new questions or issues, consider including suggestions for further research in the discussion section. Do not introduce new results in the discussion section. Be wary of mistaking the reiteration of a specific finding for an interpretation because it may confuse the reader. The description of findings [results] and the interpretation of their significance [discussion] should be distinct sections of your paper. If you choose to combine the results section and the discussion section into a single narrative, you must be clear in how you report the information discovered and your own interpretation of each finding. Use of the first person is generally acceptable. Using first person can help emphasize a point or illustrate a contrasting finding. However, keep in mind that too much use of the first person can actually distract the reader from the main points [i. Department of English Writing Guide. George Mason University; Discussion. Bates College; Hess, Dean R. University College Writing Centre. University of Toronto; Sauaia, A. Writing in Psychology course syllabus. University of Florida; Yellin, Linda L. Allyn and Bacon, Interpretation is a subjective exercise. As such, you should always approach the selection and interpretation of your findings introspectively and to think critically about the possibility of judgmental biases unintentionally entering into discussions about the

significance of your work. With this in mind, be careful that you do not read more into the findings than can be supported by the evidence you have gathered. Remember that the data are the data: One of the most common mistakes that you can make when discussing the results of your study is to present a superficial interpretation of the findings that more or less re-states the results section of your paper. Obviously, you must refer to your results when discussing them, but focus on the interpretation of those results and their significance in relation to the research problem, not the data itself. The discussion section should remain focused on the findings of your study. For example, if the purpose of your research was to measure the impact of foreign aid on increasing access to education among the poor in Bangladesh, it would not be appropriate to speculate about how your findings might apply to populations in other countries without drawing from existing studies to support your claim or if analysis of other countries was not a part of your original research design. If you feel compelled to speculate, do so in the form of describing possible implications or explaining possible impacts. Be certain that you clearly identify your comments as speculation or as a suggestion for where further research is needed.

Chapter 6 : Writing Scientific Papers

If your paper is proposing a new method, you need to include detailed information so a knowledgeable reader can reproduce the experiment. However, do not repeat the details of established methods; use References and Supporting Materials to indicate the previously published procedures.

Do not begin each section on a new page. If one section ends part of the way down the page, the next section heading follows immediately on the same page. One important general rule to keep in mind is that a scientific paper is a report about something that has been done in the past. The present tense is, are is used when stating generalizations or conclusions. The present tense is most often used in the Introduction, Discussion and Conclusion sections of papers. The paper should read as a narrative in which the author describes what was done and what results were obtained from that work. By reading the title, the work being reported should be clear to the reader without having to read the paper itself. The title, "A Biology Lab Report", tells the reader nothing. An example of a good, self-explanatory title would be: This title reports exactly what the researcher has done by stating three things: The environmental factors that were manipulated light, temperature. The parameter that was measured growth. The specific organism that was studied the bacterium, Escherichia coli. If the title had been only "Effects of Light and Temperature on Escherichia coli ", the reader would have to guess which parameters were measured. That is, were the effects on reproduction, survival, dry weight or something else? If the title had been "Effect of Environmental Factors on Growth of Escherichia coli ", the reader would not know which environmental factors were manipulated. If the title had been "Effects of Light and Temperature on the Growth of an Organism", then the reader would not know which organism was studied. In any of the above cases, the reader would be forced to read more of the paper to understand what the researcher had done. If several factors were manipulated, all of them do not have to be listed. Instead, "Effects of Several Environmental Factors on Growth of Populations of Escherichia coli " if more than two or three factors were manipulated would be appropriate. The same applies if more than two or three organisms were studied. The researcher would then include the names of the bacteria in the Materials and Methods section of the paper. An abstract is more than a summary. A summary is a brief restatement of preceding text that is intended to orient a reader who has studied the preceding text. An abstract is intended to be self-explanatory without reference to the paper, but is not a substitute for the paper. The abstract should present, in about words, the purpose of the paper, general materials and methods including, if any, the scientific and common names of organisms , summarized results, and the major conclusions. Do not include any information that is not contained in the body of the paper. Exclude detailed descriptions of organisms, materials and methods. Tables or figures, references to tables or figures, or references to literature cited usually are not included in this section. The abstract is usually written last. An easy way to write the abstract is to extract the most important points from each section of the paper and then use those points to construct a brief description of your study. It should give readers enough information to appreciate your specific objectives within a larger theoretical framework. After placing your work in a broader context, you should state the specific questions to be answered. This section may also include background information about the problem such as a summary of any research that has been done on the problem in the past and how the present experiment will help to clarify or expand the knowledge in this general area. All background information gathered from other sources must, of course, be appropriately cited. Proper citation of references will be described later. A helpful strategy in this section is to go from the general, theoretical framework to your specific question. However, do not make the Introduction too broad. Remember that you are writing for classmates who have knowledge similar to yours. Present only the most relevant ideas and get quickly to the point of the paper. For examples, see the Appendix. The researcher describes the experimental design, the apparatus, methods of gathering data and type of control. If any work was done in a natural habitat, the worker describes the study area, states its location and explains when the work was done. If specimens were collected for study, where and when that material was collected are stated. **DO NOT** write this section as though it were directions in a laboratory exercise book. First pour agar into six petri plates. Then inoculate the plates with the bacteria. Then put the plates into the

incubator. Simply describe how the experiment was done: Six petri plates were prepared with agar and inoculated with the bacteria. The plates were incubated for ten hours. The materials that were used in the research are simply mentioned in the narrative as the experimental procedure is described in detail. If well-known methods were used without changes, simply name the methods. If modified standard techniques were used, describe the changes.

RESULTS Here the researcher presents summarized data for inspection using narrative text and, where appropriate, tables and figures to display summarized data. Only the results are presented. No interpretation of the data or conclusions about what the data might mean are given in this section. Do not present raw data! Do not repeat extensively in the text the data you have presented in tables and figures. But, do not restrict yourself to passing comments either. For example, only stating that "Results are shown in Table 1. The text describes the data presented in the tables and figures and calls attention to the important data that the researcher will discuss in the Discussion section and will use to support Conclusions. Rules to follow when constructing and presenting figures and tables are presented in a later section of this guide.

DISCUSSION Here, the researcher interprets the data in terms of any patterns that were observed, any relationships among experimental variables that are important and any correlations between variables that are discernible. The author should include any explanations of how the results differed from those hypothesized, or how the results were either different from or similar to those of any related experiments performed by other researchers. Remember that experiments do not always need to show major differences or trends to be important. A useful strategy in discussing your experiment is to relate your specific results back to the broad theoretical context presented in the Introduction. Since your Introduction went from the general to a specific question, going from the specific back to the general will help to tie your ideas and arguments together. This section should not offer any reasons for those particular conclusions--these should have been presented in the Discussion section. By looking at only the Introduction and Conclusions sections, a reader should have a good idea of what the researcher has investigated and discovered even though the specific details of how the work was done would not be known. If your work has been supported by a grant, you would also give credit for that in this section. It provides the readers with the information needed should they want to refer to the original literature on the general problem. Note that the Literature Cited section includes only those references that were actually mentioned cited in the paper. Any other information that the researcher may have read about the problem but did not mention in the paper is not included in this section. This is why the section is called "Literature Cited" instead of "References" or "Bibliography". The system of citing reference material in scientific journals varies with the particular journal. The method that you will follow is the "author-date" system. Listed below are several examples of how citations should be presented in the text of your paper. The name s of the author s and year of publication are included in the body of the text. Sentence structure determines the placement of the parentheses. The following citations illustrate the details of punctuation and order of information for a journal article, book, Internet source, and your laboratory packet.

Occurrence of indoleacetic acid in the bryophytes. Processes of Organic Evolution. Salt Tolerance in *Phaseolus vulgaris*. Colby Custom Publishing

Generally, most references will be to the primary literature. Popular literature and the Internet should be used sparingly and with caution. Other sources such as book chapters and pamphlets typically have their own specific citation formats. If necessary, be sure to find out what these formats are and use them appropriately. For a much more detailed discussion about writing scientific papers, consult: Council of Biology Editors, Inc. This guide is based on a paper by Gubanich, A. Writing the scientific paper in the investigative lab. Examples from the scientific literature that illustrate material in various sections of a scientific paper.

Revision of the theory of phototropism in plants: However, determination of the absolute amounts of indoleacetic acid IAA in the agar blocks, using a physicochemical assay following purification, showed that the IAA was evenly distributed in the blocks from the illuminated and shaded sides. In the blocks from the shaded and dark-control halves the amounts of IAA were 2. Chromatography of the diffusates prior to the Avena curvature test demonstrated that the amounts of two growth inhibitors, especially of the more polar one, were significantly higher in the agar blocks from the illuminated side than in those from the shaded side and the dark control. These results show that the basic experiment from which the Cholodny-Went theory was derived does not justify this theory. The data rather indicate that phototropism is caused by the

light-induced, local accumulation of growth inhibitors against a background of even auxin distribution, the diffusion of auxin being unaffected.

Chapter 7 : How to Write Guide: Sections of the Paper

Scientific articles exemplify standard functional units constraining argumentative structures. Severe space limitations demand every paragraph and illustration contribute to establishing the paper's claims. Philosophical testing and confirmation models should take into account each paragraph, table.

Overview[edit] Fig. Wineglass model for IMRAD structure. The above scheme schematically shows how to line up the information in IMRAD writing. It has two characteristics, first one is "top-bottom symmetric shape", second one is "change of width", that means "the top is wide and it narrows towards the middle, and then widens again as it goes down toward the bottom". First one, "top-bottom symmetric shape" represents the symmetry of the story development. Second one, the change of the width of above diagram, represents the change of generality of the viewpoint. Original research articles are typically structured in this basic order [2] [3] [4] Introduction – Why was the study undertaken? What was the research question, the tested hypothesis or the purpose of the research? Methods – When, where, and how was the study done? What materials were used or who was included in the study groups patients, etc. Results – What answer was found to the research question; what did the study find? Was the tested hypothesis true? Discussion – What might the answer imply and why does it matter? How does it fit in with what other researchers have found? What are the perspectives for future research? First one is "top-bottom symmetric shape" and Second one is "changing width" i. The First one, "top-bottom symmetric shape", represents the symmetry of the story development. Note the shape of the top trapezoid representing the structure of Introduction and the shape of the trapezoid at the bottom are reversed. See the relationship between abovementioned a, b and e, f. The Second one, "the change of the width" of the schema shown in Fig. As along the flow of the story development, when the viewpoints are more general, the width of the diagram is expressed wider, and when they are more specialized and focused, the width is expressed narrower. As the standard format of academic journals[edit] The IMRAD format has been adopted by a steadily increasing number of academic journals since the first half of the 20th century. The IMRAD structure has come to dominate academic writing in the sciences, most notably in empirical biomedicine. Although the IMRAD structure originates in the empirical sciences, it now also regularly appears in academic journals across a wide range of disciplines. Many scientific journals now not only prefer this structure but also use the IMRAD acronym as an instructional device in the instructions to their authors, recommending the use of the four terms as main headings. For example, it is explicitly recommended in the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" issued by the International Committee of Medical Journal Editors previously called the Vancouver guidelines: The text of observational and experimental articles is usually but not necessarily divided into the following sections: Introduction, Methods, Results, and Discussion. This so-called "IMRAD" structure is not an arbitrary publication format but rather a direct reflection of the process of scientific discovery. Long articles may need subheadings within some sections especially Results and Discussion to clarify their content. Other types of articles, such as case reports, reviews, and editorials, probably need to be formatted differently. It allows the most relevant information to be presented clearly and logically to the readership, by summarizing the research process in an ideal sequence and without unnecessary detail. Caveats[edit] The idealised sequence of the IMRAD structure has on occasion been criticised for being too rigid and simplistic. In a radio talk in the Nobel laureate Peter Medawar even criticised this instructive text structure for not giving a realistic representation of the thought processes of the writing scientist: Medawar and others have given testimony both to the importance and to the limitations of the device. Abstract considerations[edit] In addition to the scientific article itself a brief abstract is usually required for publication. The abstract should, however, be composed to function as an autonomous text, even if some authors and readers may think of it as an almost integral part of the article. The increasing importance of well-formed autonomous abstracts may well be a consequence of the increasing use of searchable digital abstract archives, where a well-formed abstract will dramatically increase the probability for an article to be found by its optimal readership. A few variations can occur, as follows: Many journals have a convention of omitting the "Introduction" heading, based on the idea that the reader who

begins reading an article does not need to be told that the beginning of the text is the introduction. The same considerations are true regarding the presence or proscription of an explicit "Abstract" heading. In some journals, the "Methods" heading may vary, being "Methods and materials", "Materials and methods", or similar phrases. Some journals mandate that exactly the same wording for this heading be used for all articles without exception; other journals reasonably accept whatever each submitted manuscript contains, as long as it is one of these sensible variants. Are you just making money off of saying it? How is it relevant to my clinical practice? Thus reporting guidelines guidelines for how best to report information arose. The general theme has been to create templates and checklists with the message to the user being, "your article is not complete until you have done all of these things. Other such standards , mostly developed in the s through s, are listed below. In fact, from the most rigorous versions of the evidence-based perspective, the distance to go is still quite formidable.

Chapter 8 : How to write a good abstract for a scientific paper or conference presentation

IMRAD (I ntroduction, Methods, Results, [and] Discussion) is a mnemonic for the major components of a scientific paper. These elements are included in the overall structure outlined below. These elements are included in the overall structure outlined below.

Describe the sampling strategy Describe the intervention if applicable Identify the main study variables Describe data collection instruments and procedures Outline analysis methods Report on data collection and recruitment response rates, etc. Describe participants demographic, clinical condition, etc. Present key findings with respect to the central research question Present secondary findings secondary outcomes, subgroup analyses, etc. Discussion State the main findings of the study Discuss the main results with reference to previous research Discuss policy and practice implications of the results Analyse the strengths and limitations of the study Offer perspectives for future work View Large The Methods section should provide the readers with sufficient detail about the study methods to be able to reproduce the study if so desired. Thus, this section should be specific, concrete, technical, and fairly detailed. The study setting, the sampling strategy used, instruments, data collection methods, and analysis strategies should be described. In the case of qualitative research studies, it is also useful to tell the reader which research tradition the study utilizes and to link the choice of methodological strategies with the research goals [3]. The Results section is typically fairly straightforward and factual. All results that relate to the research question should be given in detail, including simple counts and percentages. Resist the temptation to demonstrate analytic ability and the richness of the dataset by providing numerous tables of non-essential results. The Discussion section allows the most freedom. This is why the Discussion is the most difficult to write, and is often the weakest part of a paper. Structured Discussion sections have been proposed by some journal editors [4]. While strict adherence to such rules may not be necessary, following a plan such as that proposed in Table 1 may help the novice writer stay on track. References should be used wisely. Key assertions should be referenced, as well as the methods and instruments used. However, unless the paper is a comprehensive review of a topic, there is no need to be exhaustive. Also, references to unpublished work, to documents in the grey literature technical reports , or to any source that the reader will have difficulty finding or understanding should be avoided. The basics Having the structure of the paper in place is a good start. However, there are many details that have to be attended to while writing. Another concerns non-native writers of English: A paper usually goes through several drafts before it is submitted. When revising a paper, it is useful to keep an eye out for the most common mistakes Table 2. If you avoid all those, your paper should be in good shape. Table 2 Common mistakes seen in manuscripts submitted to this journal The research question is not specified The stated aim of the paper is tautological e.

Chapter 9 : How to write a scientific abstract in six easy steps | Serendipity

The main thing to remember with any research paper is that it is based on an hourglass structure. It begins with general information and undertaking a literature review, and becomes more specific as you nail down a research problem and hypothesis.

As much pleasure a publication may bring to a scientist, the process of scientific writing and publication may seem an uphill task to a budding researcher. Anyone new to the research field may wonder what a research paper really looks like. My aim in writing this article is to introduce students to the world of scientific research article writing. Getting into the details of this field is beyond the scope of this article, but I would like to highlight the basic structure of a scientific paper. It is imperative to mention at the outset, that it takes some amount of experience to master the skills of good scientific and technical writing, but I hope this article can serve as an impetus to commence your journey. To begin writing a research paper, also called a manuscript, the first step would be to identify the journal you would like to submit it for publication. Journals have preset rules and guidelines, which authors need to follow while writing their article. These rules include, but are not limited to, the style and format of text, tables and figures, nomenclature for headings, numbering systems, bibliographic style and word count. Hence it is important to use these guidelines as a base while writing your article.

Title The title of your paper is as important as the rest of your text. This is what will draw the attention of a potential reader towards your article. Thus, it is important that you make it short and catchy. There are many ways of writing a title; the most effective way would be to highlight the key finding of your research in simple language. You should pay particular attention to the format, style and length of your title to maintain its clarity.

Authors and Affiliations The name of the author s along with their affiliations should follow the title of your paper. Author names should be in the descending order of their contribution to the research work. Usually the principal investigator or the scientist who guides the research project is mentioned last in the list of authors. There after mention the name and address of the university or institution that the authors are affiliated to. If there are authors from different institutions, mention both institutions, and differentiate authors affiliated to a particular institution using a specific identification mark.

The abstract should do just this. There are two types of abstracts: An informative abstract is a gist of your research article. Thus it should present the aim and salient findings of your study in a succinct manner, while avoiding any explanations. An indicative abstract, mainly used for review articles, contains an overview of the subjects covered. Many readers tend to read the abstract and conclusions rather than the whole article. Hence it is important that these segments are well articulated. Many research journals restrict the number of words you can use in the abstract and conclusions or for that matter the whole research article. Hence you should pay particular attention to such details.

Keywords Some journals require a set of keywords to be listed from your research article. The list of keywords appears after the abstract and before the introduction section. Pay careful attention to the words you choose as these would help other researchers find your paper while they reference for research articles.

Introduction This section should help the readers understand the importance of your topic of study, in light of past research work and future scope. It is best to divide your introduction into three parts: It is also vital to mention the novelty of your research and the importance to study it. Correctly mention the references to past research work in the text where they appear.

Materials and Methods Just like writing any recipe in a cookbook, the materials and methods section deals with the experimental design or protocol and the details of animate and inanimate materials used for the study. Universally recognized techniques need not be explained in detail. Instead, simply name the principle it is based on or the internationally recognized test number along with referencing details such as a handbook of test methods. Novel methods should be described at length. If applicable, you can use pictures or images to better explain novel techniques. By mentioning details of your experimental technique, it also becomes easier for other trained researchers to conduct the same experiments if they desire. Another method for explaining your experimental protocol is by using a flowchart. This will help you describe your sequence in a more efficient manner along with keeping

the word count of your paper in check. Results and Discussion There are two ways in which this section appears in journals. Some journals combine results and discussion under one section, while others treat them as two different sections. Avoid mentioning findings that are irrelevant, but do not deliberately exclude data that may contradict your arguments or hypothesis. This is considered unethical; instead try to give reasons for the uncharacteristic nature of this data. There are many ways in which you can present your data, for example inductive or deductive manner, by level of importance, chronologically, problem solving and so on. The nature of your study and your individual preference will determine the choice you make in writing this section. Having heaps of data are of no importance if you cannot deduce valuable findings from them. You should systematically state what you interpret or infer from the data you have collected, against the background of existing knowledge. Refer to the hypothesis you stated in the Introduction and explain if and how your findings support your claims. You could also suggest alternative ways of resolving such conflicts. Avoid making exaggerated claims and rely on facts rather than speculations. In this section, thank any individual or institution from whom you received substantial help, either in the form of technical support, materials or funding for your research. Also specify the nature of help you received from them. Refer to your journal for any specifications they may have for this section. Bibliographical references Any reference to past research work that you have cited in your paper should be systematically listed both in the body of your text as well as a list at the end of your manuscript. Citing References in the Body of your text: There are two main styles of citing references in the body of your paper: In the Harvard style, the name of the author surname in full and year of publication is mentioned in the text, while in the Vancouver system a number in superscript is assigned either chronologically or alphabetically as they appear in the list of references. Citing References at the end of your paper: You should pay attention to the format your journal specifies for listing references. Using a good reference manager such as Endnote or Zotero will automatically format the references according to journal requirements, making the process efficient. If you follow these general rules, you will be equipped to write a well-formatted article. Now that you know the basic structure of a scientific paper, the only thing left for you to do is to begin transforming your hard earned data into a scientific publication. Nothing can be more fulfilling than sharing your scientific achievements. Exchange your scientific knowledge to the world around you and explore its endless pool of knowledge. You will be amazed by the possibilities that await you!

Scientific Writing Tips Tags: