Instructions to Authors

Follow these instructions or your paper will be returned and incur late penalties.

One of the learning objectives of your research project in the course is to develop your scientific writing skills. In science, writing is the most important means of communicating research findings. Major scientific findings are never kept secret. Instead, scientists share their ideas and results with other scientists, encouraging critical review and alternate interpretations from colleagues and the entire scientific community. In most cases, scientists report the results of their research activities in scientific journals in a standard written format. In this course, you will practice writing using this same standard scientific format and style.

4.0 TIP: Write like a scientist. Write your papers so that anyone who reads your manuscript could not tell it was from a student in a class, but assumes it must have been from a scientist in a research lab at Michigan State.

A scientific paper usually includes the following parts: a TITLE (statement of the question or problem), an ABSTRACT (short summary of the paper), an INTRODUCTION (background and significance of the problem), a METHODS section (report of exactly what you did), a RESULTS section (presentation of data), a DISCUSSION section (interpretation and discussion of your results), and REFERENCES (books and periodicals used). Data is also represented by FIGURES and TABLES.

Throughout the laboratory, you will practice scientific research and writing. Your papers will be reviewed by the course professor, TAs, and your peers in order to point out your areas of weakness and make suggestions for future improvements. By the time you have completed the course, you will have submitted the equivalent of two full scientific papers. If you are not certain about the level of independence and what constitutes plagiarism in this program, ask your instructor to clarify the class policy. Plagiarism will not be taken lightly and will be evaluated by instructors and software at turnitin.com. See syllabus for more info.

Predictions: Science is not about explanation but in fact it is about the ability to predict. All scientists must have models or hypotheses that can be used to then make predictions of what will occur. Thus prediction is a very important part of writing you papers. As a result in your early DRAFT1 and DRAFT2 in many cases your predictions may be all the data you have on a certain experiment and thus they should be well supported by papers from the literature. Use future tense when discussing Predictions. In general whether it’s in the Abstract, Introduction, Results or Discussion, whenever you discuss something that you predict it should be in the format of:

“We predict..[what].. because..[rationale].. (citation of paper).”

Note: A hypothesis is different than a prediction. The hypothesis is the model that explains how you believe things are working (e.g. we hypothesize electricity sparks gas in the cylinders of a car engine)
while the prediction is what you think should happen during the experiment (e.g. if hydrogen gas is injected into the cylinder of a functioning engine we predict there should be a significant explosion).

**Overview of Manuscript Sequence & Format**

*(This is what professional journals expect)*

1. Page one is the Title Page (≤100 characters in title)
2. Page two will have ONLY the Abstract (≤250 words)
3. Page three will start with the Introduction. The Methods, Results, and Discussion sections can follow without starting a new page for each one (although you may start a new page if you are near the bottom of the current page). Clearly label each section with the section headings (ex. Introduction) and who authored it (Written by: Jill Sanders, Revised by: Bob Roberts).
4. The *Introduction* will provide the reader with the background information necessary to understand the rest of the paper.
5. The *Methods* section will list materials used (Bought Vitamin C with Rose hips from the General Nutrition Store (GNC) 324 E. Grand River East Lansing MI) how stock solutions were prepared and explain exactly what you did in your research. After reading the Methods section, an incoming student should be able to repeat your work. Reference the original protocol.
6. The *Results* section follows Methods. This section will clearly and succinctly state what you observed upon performing each experiment.
7. The *Discussion* section follows Results. In this section you will discuss the significance of results and how your results relate with research performed by others.
8. The *References* section follows the Discussion. This is a list of the references cited within the paper.
9. Start a new page with the *Figures* section after the References. Figures will be sequentially numbered in the order that they were cited in the Results section (figures are most always cited ONLY in the Results section, not in Methods, not in Discussion). One figure per page with extensive figure legend paragraph ONLY at the bottom of the figure. The first sentence of a figure legend is its title. Follow the title with sentences explaining the figure as if someone did not have the Results section or in fact any other part of the paper available as a reference.
10. The *Tables* section will follow the Figures section. Tables get a title ONLY on the top with some explanation. Tables will be sequentially numbered in the order that they were cited in the Results section (Tables are most always cited ONLY in the Results). One table per page.
11. Figures and tables MUST be created on a computer unless otherwise instructed.
12. After the Tables section, a single white page will follow entitled, *Appendix*. Then append any laboratory notebook pages that indicate signed data for all members (photocopies from your notebook) and a photocopy of the first page of any articles cited and referenced in report.
13. Double space or 1.5 space typeface is required. Preferred font size is 12 point.

*Once returned, rejected papers (like late papers) lose one point in the first 24 hrs grace period but then 10% (48hrs), 20% (72hrs) of the total points.*

A more detailed description of each section of a scientific paper follows also, review the published papers provided in the course packet for examples. As you write your paper, clearly label each sec-
tion (except the title page), placing the title of the section on a separate line, centered, bold, but not underlined (like shown below).

**Title Page and Title**

The title page is the first page of the paper and includes the title of the paper, your name, the course title, your lab time, your lab instructors’ names, the due date for the paper, and your groups’ website address. The title should be as short as possible and as long as necessary to communicate to the reader the question being answered in the paper. Consider the following titles for a paper that describes the molecular mechanism of an antiviral drug.

1. “Inhibition of Mengovirus Replication by Dipyridamole”
2. “Antiviral Action of Dipyridamole”
3. “A Study Examining the Inhibitory Effects of the Drug Dipyridamole on Mengovirus Replication”

Title 1 is short and communicates the question being investigated. It conveys the mechanism of action (inhibition of replication), the name of the virus being inhibited (Mengovirus), and the name of the drug doing the inhibiting (Dipyridamole). Title 2 is short but too vague for the reader to know the subject matter of the paper. Title 3 is too long. The words “A Study Examining” are superfluous, and “Drug” and is redundant.

Place the title about 7 cm from the top of the title page. Place “by” and your name(s) in the center of the page, and place the course title, lab time, lab instructors’ names, due date, and your groups’ website address, each on a separate centered line, at the bottom of the page. Leave about 5 cm of white space below this information.

**Abstract**

The abstract is placed at the beginning of the second page of the paper, after the title page. The abstract summarizes the question being investigated in the paper, the methods used in the experiment, the results, and the conclusions drawn. The reader should be able to determine the major topics in the paper without reading the entire paper. As mentioned previously, predictions are an essential element of science and thus should appear in the Abstract and in the format: “We predict..[what].. because..[rationale].. (citation of paper).”

**Introduction**

Start the introduction on page three. The introduction should generally be short, only 4-5 paragraphs in length and focus are background information of the following types:

1. Describe the question and hypothesis being investigated and background on the importance of the topic.
2. Review the background information that will allow the reader to understand the purpose and topics of the paper. There is usually a paragraph on the specimens studied, also one that pro-
vides evidence to support the hypothesis posed. A hypothesis is an educated guess; the Introduction should provide the “education.” Include only information that directly prepares the reader to understand the question investigated. Most of this information should come from outside sources, such as scientific journals or books dealing with the topic you are investigating*.

3. In a paragraph state background on the methods chosen to investigate the hypothesis. Explain how these methods will address the question and describe the predicted outcomes. Why were they chosen?

4. In the last paragraph briefly state a hint of the results and conclusions of the investigations (or predictions). This generally comes only at the very end of the Introduction.

*All sources of information must be referenced and included in the References section of the paper, but the introduction must be in your own words. No quotations are permitted in any part of the paper. Refer to the references when appropriate. As you describe your investigation, include only the question and hypothesis that you actually investigated. It is a good idea to write down each item (question, hypothesis, supporting evidence, prediction) before you begin to write your introduction.

Write the introduction in past tense when referring to elements of your experimental investigation that are completed. When relating the background information, use present tense when referring to another investigator’s published work. Use future tense when discussing Predictions.

**Methods**

The Methods section describes your experiment in such a way that it may be repeated exactly. Make the Methods professional just like in published papers, but target as your audience a student in LBC-144. The majority of the information in this section comes from the Procedures or Protocols section of the Laboratory Manual and in your paper, this information should not be a list of steps. Write the Methods section in a paragraph format in past tense. Be sure to include levels of treatment, numbers of replications, and control of treatments. If you are working with living organisms, include the species and the sex of the research organism. Do not include failed attempts unless other investigators may wish to try the technique used. Do not try to justify your procedures in this section of the report.

If you describe an experiment from the lab manual, unless instructed otherwise, you may simply refer to the procedures listed in the lab manual (and page numbers). Under those circumstances, your Methods section should point out changes in procedure that are not indicated in the Lab Manual. When writing a full Methods section (with no reference to the Lab Manual), write these procedures concisely, but in paragraph form. The difficulty comes as you decide the level of detail to include in your paragraphs. You must determine which details are essential for the investigator to repeat the experiment. For example, if in your experiment you incubated potato pieces in different concentrations of sucrose solution, it would not be necessary to explain that the pieces were incubated in plastic cups labeled with a wax marking pencil. In this case, the molarity of the sucrose solutions, the size of the potato pieces and how they were obtained, and the amount of incubation solution are important items to include.
Results

The Results section consists of two components: (1) one or more paragraphs that describe the results of each experiment/test and include the actual data with observations, specific numbers [and units] and math, (2) reference to figures (graphs, diagrams, pictures), and reference to tables.

In referencing figures, remember to number figures and tables consecutively in the order that they are mentioned in this section. Refer to figures and tables within the paragraph as you describe your results, using the word Figure or Table in parentheses, followed by its number, for example, “(Figure 1).” Avoid citing a figure with a full sentence or statement such as, “please see figure 1 for graphed data points” or even just “please see table 2.” DO NOT place each figure or table at the end of each paragraph in which it is cited. Place figures and tables after the References section. If you have performed a statistical analysis of your data, such as chi-squared, include this data in the Results section. Explain what calculations you did and the result and direct the reader to the Methods section for more details. Then show an example of the results and refer the reader to a table with all the data.

The most common error a student makes is only making general comments and not including actual data (ie the results) in the Results. Results should include detailed observations (what did you see: odor, texture, etc.) and specific findings (what did you record: 15 grams, 20 degrees C, 20% increase, 32,000 cells etc.). Report your data as accurately as possible in the order that they happened. It is important to have separate paragraphs and topic sentences that introduce the results of each test but do not spend much time discussing the meaning of your results in this section, save that for the Discussion.

For “Predicted Results” - which will be the only focus of Draft 1 and will be included in subsequent drafts - these are what you predict or expect will happen, and these predictions must be based upon the primary literature you have gathered throughout your research on your topic/thesis. When including predictions follow this format: “We predict..[what].. because..[rationale].. (citation of a published paper or source).”

Discussion

The Discussion section is where you will analyze and interpret the results of your experiments. The Discussion should show a possible relationship between observed facts—those observed by you and those observed by others and reported in published research papers. Write as clearly and succinctly as possible. A good Discussion will include the following:

1. Summarize the Introduction and restate the question and hypothesis being addressed.
2. Briefly summarize the results of the experiments. Do not include many details regarding experimental procedures.
3. Interpret the results. Explain how the results answer the questions posed. State whether your results support or refute your hypothesis. Do not use the word “prove” in your conclusions. Your results will support, verify, or confirm your hypothesis. They also may negate, refute, or contradict your hypothesis. The word prove is not appropriate in scientific writing.
4. Discuss how your results and interpretations relate with previously published research. This will require you to cite outside references. Some may come from the Introduction, while you
will also find new references that specifically relate to your findings. You can speculate and propose theoretical implications of your work.

5. Describe weaknesses in experimental design or technical difficulties that arose during the research. Explain how these problems specifically affected the outcome of the research. Any human errors (spills, miscalculations, etc) discussed should have been then corrected by certain steps.

6. Discuss experiments that would be performed if the research were to be continued. Explain how those experiments would contribute to answering the questions addressed by the research.

**Figures**

All figures should be computer generated. The format of the figure will depend on the type of data collected. Your figures will include mostly photographs and graphs. The photos and graphs must be done in a professional manner and include computer generated labels when appropriate, and always with only one figure per page. Under each photo or graph, there must be a legend paragraph. The legend paragraph will include the Figure number, a title sentence, and a description of what was done in the experiment and shown in different labeled parts of the figure. A reader must be able to understand the general concept of the experiment performed without reading the Methods section. In fact if a student from LBC-144 picks up a single piece of paper with one of your figures on it, they should be able to explain to you what that experiment is about from the legend.

![Figure 1](image1.png)

**Figure 1.** Preparation of corn root and corn stalk samples for sugar analysis. Corn samples were cut into units no greater than 4 mm3 using a surgical scalpel. Three stalk samples of 70 grams each and three root samples of 80 grams each were prepared. Root 1 (R1), Root 2 (R2), Root 3 (R3), Stalk 1 (S1), Stalk 2 (S2), and Stalk 3 (S3).

![Figure 2](image2.png)

**Figure 2.** DPM and Virus Yield. HeLa cell monolayers were infected with Mengovirus at a multiplicity of 50 pfu/cell. DPM+ samples had 80 µM DPM (in ethanol) added to the media at the time of infection. DPM- samples were dosed with an equivalent volume of ethanol. Medium from DPM+
cultures was exchanged with drug-free medium at the indicated times. Virus was harvested at 8 hrs PI and the titer determined by plaque assay.

**Tables**

While Figures are often used in papers (graphs, photographs, gel images) tables are rare. Tables should only be used when all the data being presented cannot be reported in a simple and comprehensible manner in the Results section. The title appears at the top of the table; there is no legend. A footnote may be necessary to clarify an important point in the table.

**Table 1.** DNA glycosylases in human cell nuclei.

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Size (amino acid residues)</th>
<th>Gene location at chromosome</th>
<th>Altered base removed from DNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNG</td>
<td>313</td>
<td>12q23–q24</td>
<td>U and 5-hydroxyuracil</td>
</tr>
<tr>
<td>TDG</td>
<td>410</td>
<td>12q24.1</td>
<td>U or T opposite G, etheno- cytosine</td>
</tr>
<tr>
<td>hSMUG1</td>
<td>270</td>
<td>12q13.1–q14</td>
<td>U (preferentially from single-strand DNA)</td>
</tr>
<tr>
<td>MBD4</td>
<td>580</td>
<td>3q21</td>
<td>U or T opposite G at CpG sequences</td>
</tr>
<tr>
<td>hOGG1</td>
<td>345</td>
<td>3p25</td>
<td>8-oxo G opposite C, formamidopyrimidine</td>
</tr>
<tr>
<td>MYH</td>
<td>521</td>
<td>1p32.1–p34.3</td>
<td>A opposite 8-oxo G</td>
</tr>
<tr>
<td>hNTH1</td>
<td>312</td>
<td>16p13.2–p13.3</td>
<td>Thymine glycol, cytosine glycol, dihydrouracil, formamidopyrimidine</td>
</tr>
<tr>
<td>MPG</td>
<td>293</td>
<td>16p (near telomere)</td>
<td>3-MeA, etheno adenine, hypoxanthine</td>
</tr>
</tbody>
</table>

**Table 2.** Mengovirus plaque phenotypes in the presence of DPM.

<table>
<thead>
<tr>
<th>Concentration, µM DPM</th>
<th>Plaque Reduction (%)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Relative Plaque Size&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>60</td>
<td>98</td>
<td>minute</td>
</tr>
<tr>
<td>40</td>
<td>93</td>
<td>+</td>
</tr>
<tr>
<td>20</td>
<td>68</td>
<td>++</td>
</tr>
<tr>
<td>10</td>
<td>25</td>
<td>++</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>+++</td>
</tr>
</tbody>
</table>

<sup>a</sup> Values represent the average of two experiments each done in triplicate.

<sup>b</sup> Plaques in the absence of DPM averaged about 2mm in diameter.

**Reference Citation Formatting**

A References section lists only those references cited in the paper. You will cite all the references you used when you wrote your paper. In the text of the paper, cite the references using the author's name
and publication year. If there are two authors you must state both of their names if there are greater than two authors, state the first authors name followed by et al.

For example: We predict that the 95% alcohol solution will kill all of the NIH-3T3 cells in our culture flask because Smith performed a similar experiment in his paper with another cell type (Smith et al, 1998). In previous research the p58 protein was associated with increased cell growth in C127 cells (Johnson, 2001; Benenson and Kortemeyer, 2003; Haenisch et al, 2006).

Types of Literature:

The vast collection of scientific literature can be generally divided into three categories based on how ‘close’ they are to the original experiments and descriptions of scientific phenomena. 1) **Primary literature:** The bulk of scientific journal articles are primary, meaning that they report the findings of specific experiments or descriptive studies. 2) **Secondary literature:** From time-to-time investigators write review articles or books that summarize what is and is not known about a particular topic. Rather than conducting new experiments, these authors rely heavily on the primary literature, therefore these review articles and books are considered a part of the secondary literature. 3) **Tertiary literature:** More general texts that summarize what has been reported in review articles comprise the tertiary literature.

Most new research relies heavily on previous work reported in primary literature. However, review articles can be extremely helpful in understanding how your research project fits into the larger scope of scientific investigation, and can be used as a source to locate primary literature references for the topic of interest.

Note that websites were not included in the above description of scientific literature sources. This is because they are not refereed — that is, just about anyone can publish something on the web without some impartial reader reviewing it beforehand. Web pages are often wonderful sources of information, but they can just as often be replete with bad information. At this point, it is very difficult to determine the reliability of web sources and, in general, they should generally only be used as a starting point about a particular topic. **Thus websites are only allowed as citations in DRAFT1 manuscripts.**

**Examples of Proper Citation Formatting for the listings in your Reference section:**

**Journal articles:**

*Single Author:*


*Two Authors:*


*Multiple Authors:*

If the source was published in an online journal:


Books:

Chapter within a book:


An entire book:


Theses:


The textbook:


The Lab Manual:

Cooper, et al. 2006. The LBC145 Course Pack. MSU Printing Services, East Fee Hall. Michigan State University, East Lansing, MI

A Web Site: [only allowed in DRAFT1 manuscripts and follows a text citation (Author(s), Year published).]


References (used in the creation of this appendix):

Appendix

Note everything you place in your appendix will be discarded during grading.

An Appendix section includes only materials that are not actually required in the paper and could be thrown away with no effect to the paper. Often special extra information is included here. In LBC-145 you are expected to place any laboratory notebook pages that indicated signed data for all members (photocopies from your notebook) and a photocopy of the first page of any articles cited and referenced in the report.

REMIN DERS

As you begin writing your paper, refer to the following hints on how to make your paper stronger:

1. Write clearly in short, logical, but not choppy sentences.
2. Use past tense in the Abstract, Methods, and Results sections when discussing things that have been completed. Also use past tense in the Introduction and Discussion sections when referring to your experiment. Use future tense when making predictions about future experiments.
3. Write in grammatically correct English, but use METRIC UNITS.
4. When referring to the scientific name of an organism, the genus and species should be underlined, the first letter of the genus is capitalized, both the species is in all lowercase; for example Drosophila melanogaster.