HOW TO WRITE A SCIENCE FAIR RESEARCH PAPER

The outline given below is suitable only for a report on a single experiment or related set of experiments. The form of a review paper or a report on a group of very diverse experiments would need to be modified accordingly.

USE OF SCIENTIFIC NAMES:

The scientific binomial (genus and species) of any organism should be underlined or italicized. The generic names should begin with a capital letter, while the specific name should begin with a lower-case letter.

The first time the scientific name of an organism is used in the Title, the Abstract, the Introduction, and the Methods and Materials sections of your paper, both the generic and specific names must be given in full. Thereafter, the first letter of the generic name and the full specific name can be used. For example, in a paper involving a study of the toad *Bufo americanus*, the first time it is mentioned in the Abstract, Introduction, and Materials and Methods sections its complete binomial is given, thereafter it is referred to as *B. americanus*. Common names of research organisms may be used after the organisms have been properly identified by their scientific binomials.

STYLE AND OTHER INSTRUCTIONS:

- When numbering the pages, begin with the Abstract page.
- Proper grammar should be used in your paper. You should write concisely, using a minimal number of adjectives and adverbs in each sentence. Do not use contractions of words.
- Each report should be written in your own words. Avoid the use of direct quotes if possible. Paraphrase the ideas of other authors and be sure to give the authors credit for their ideas by using appropriate citations.
- The Methods and the Data Analysis sections should be written in past tense, as should the portions of the Abstract that deal with methods and results.
- Write the methods as a series of step-wise instructions.
- Do not use personal pronouns, e.g., I, we, etc. Also, write your papers in passive voice (e.g., Something was done…) as opposed to the active voice (e.g., I or we did something…).
- Abbreviate symbols appropriately as g for gram, cm for centimeter, mL for milliliter. Note that periods are not used in abbreviations.
- Scale graphs properly; do not necessarily begin the lower left hand corner with zero.
- Do not begin a sentence with “Figure 1 shows…” or “Table 2 indicates…”. Also, do not simply state “These data can be found in Table 1.”
EVALUATION OF PAPERS:

The following criteria will be used to evaluate the sections of your papers (refer to the rubric for more detail):

**Title and Table of Contents:** (1) Does it clearly and exactly describe the research project? (2) If appropriate, is the scientific name of the research organism properly stated? (3) Includes title, name, teacher, period, grade & date (4) Table of Contents is accurate with proper page numbers

**Abstract:** (1) Does it give a good, clear, concise summary of the problem investigated, major methods employed, major results obtained, and major conclusions reached? (2) Is the scientific name of the research organism given?

**Introduction:** (1) Does it contain sufficient background information and give a general perspective? Is background information at least two pages in length? What is known about the problem? What does prior research suggest? (2) Does it include a statement of the question(s) to be investigated or the hypothesis(es) to be tested? (3) If the significance of the investigation mentioned? Explain why you selected the problem. Do you indentify the benefits to society?

**Methods (and Materials):** (1) List format. Are descriptions of procedures given clearly and concisely so the work could be repeated by another person? Are the number of trials and sample size appropriate? (2) If procedures were taken from a source such as the internet or another source, were the sources properly referenced? (3) What is the quality of the portions of the procedure that you have designed? (4) Was responsibility and care demonstrated in the procedure? (5) Are materials given as a descriptive list with metric units used throughout? (6) Are there a minimum of 3 photos with captions? (6) Is data properly identified, appropriate, self-explanatory and properly labeled.

**Data Analysis (Results):** (1) Are only “transformed data” presented or are “raw data” included? (In general, the “raw data” should not be presented in the Results section but should be included in an appendix.) (2) Are tables and/or figures used to clearly present data? (3) Are tables and figures properly numbered and labeled? (4) Do tables and figures have adequate legends, titles, and other necessary information? (5) Are important results presented in the text of the results in an objective and clear manner? (6) Are all tables and figure in this section referred to in the description of the results? (7) If appropriate, are the results of statistical analyses and testing clearly presented?

**Conclusion/Discussion:** (1) How well are the reported results interpreted? (2) How well do the results relate to the original question(s) and hypothesis(es) given in the Introduction? (3) Are the conclusions valid in the light of the reported results? (4) When appropriate, are tables and figures in the Results section referred in the Discussion? (5) Are the results compared to other previous work? (6) Are reasons given to explain any discrepancy between these results and previously reported results? (7) Are the results of any statistical tests properly interpreted?

**Sources (Literature Cited):** Both the bibliography and the literature citation within the text will be evaluated. (1) Minimum of five different sources, cited, annotated, MLA. One non-internet source. (2) Was the proper citation form used for references in the text of the paper and in the bibliography? (3) Are all works cited in the
Appendix: (1) Are the raw data clearly presented in tables? (2) Were appropriate data transformation undertaken and properly performed?

General Form: (1) Is the grammar (including spelling, tenses, sentence structure, etc.) of good quality? (2) Is the paper clear and concise, or is it unclear and unnecessarily long? (3) Has the proper format been used? (4) Is the length of the paper within the prescribed page limits?

PAPER FORMAT: You should divide your scientific paper into the following seven sections

Title Page / Table of Contents
Abstract
Introduction
Methods (and Materials)
Data Analysis (Results)
Conclusions/Discussion
Sources (Literature Cited)
Acknowledgements

The headings (except for Title Page) should actually be given in your report. The text under each heading is simply an explanation of the material to be covered. Papers must be TYPED (double-spaced) with 1 inch margins all around. Staple the pages together in the upper left hand corner (no report covers please).

Title Page
The title should be short, informative, and should accurately portray the scope of the paper and the study. Carefully choose a title for your paper reflecting the specific topic. The title page is the cover page of the paper. Center the title on the cover page. About two inches below the title type your name and the additional information as shown below.

THE TITLE OF THE PAPER
Your Name
Teacher
Grade and Period
Date

Abstract
This section should be on a separate page and should be a concise summary of the main sections of the paper – introduction, methods, results, and discussion. It should not exceed two-thirds of a double-spaced typewritten page. It should state the purpose of the study so that the reader knows the question(s) being considered or the hypothesis(es) being tested; however, it is not necessary to formally state the hypothesis(es). It should include a brief summary of the methods and materials that were used to test the hypothesis(es) and any data analyses that were used. General conclusions that were reached should be stated clearly, but you should not use tables or figures to support the conclusions. The Abstract must state every important aspect of your research in a concise manner. The abstract should not contain any literature citations or make use of any
references. Background information from previous research should not be presented in the abstract. The organisms(s) that was (were) used should be indicated by the scientific binomial (genus and species) in the Abstract. Only this section should be presented on a page by itself. The remaining sections may start in the middle of a page.

**Introduction**

Begin this section on a new page, which should be page two of your paper. Note that all remaining sections may begin in the middle of a page. This section should be relatively brief. It should not exceed one to two double-spaced typewritten pages. It should summarize previous work that is relevant to your study. You should avoid using direct quotations from the literature unless it is absolutely necessary. All references to previous work should be properly cited (see the section “Literature Citation” for the proper format). It should contain enough background information to make clear the significance of your investigation and the rationale for your approach to the study. The Introduction should present the observations that led to the development of the research question and hypotheses and hypothesis being investigated in the study. The observations presented may be the results of previous studies done by your or by someone else. In addition, the Introduction should state the question(s) being considered and/or the hypotheses being investigated and the organism(s) used in the study.

**Methods (and Materials)**

In this section you clearly describe the methods and materials that you used in your experiments. This section should be written in the past tense as it is a description of procedures that were used in the past. This section should be written as a list of steps. You should prepare a separate list of materials and equipment used in the study. Special pieces of equipment and any special uses of equipment should be mentioned (include the models and name brands of equipment used, if applicable), but it is not necessary to describe routine procedures with common laboratory equipment. For example you do not need to mention that a particular solution was measured with a graduated cylinder or with a pipette. However, it would be appropriate to indicate how much of a given solution was used in a particular procedure. You may assume some basic scientific knowledge on the part of the reader. Use your discretion as to the amount of detail to be included. Some procedures may be referenced if the technique is described elsewhere. Include comments on the types of statistical tests used to evaluate data in this section.

Always give the full, scientific name of the organisms used (except in the case of humans). The full genus and species should be given the first time it is mentioned, e.g., *Eschrichtius robustus*, with the name of the authority (if applicable) following. Thereafter, the genus sand species may be abbreviated as *E. robustus*. The genus and species must be given in full each time if possible ambiguities arose, i.e., you also used an organism *Exceellentia robustus* (Ryan). If geographic variation or acclimation of acclimation of the organisms might influence your results, then the source of your material and a description of the prevailing environmental conditions should also be included. If seasonal or diurnal variations are of importance in your study, then reference to the time and or season when the experiment was conducted is necessary. It may also be important to indicate the age, weight, sex, physical condition, etc. of your subjects.
Data Analysis (Results)

The results of the study should be presented in the form of tables and figures. In addition there should be a brief written description of the data. The text should clarify the results of the study and should point out the most important features of the tables and figures. The narrative portion of the results section should tell the reader what you want the reader to see when he or she is looking at the tables and figures. Specific figures and table should be referred to when the results are being described. For example: “As seen in Figure 1……” or “The results of….. are summarized in Table 1”. In general, one should not present “raw data” in the results section. Instead the data should be presented in a transformed fashion. For example, one may find it appropriate to perform a data transformation in which percentages or means and stand deviations are calculated for the data. The percentages and/or means and standard deviations should then be presented in a table and/or figure. In addition, the results of any statistical analyses of the data should be presented in this section. The “raw data” and the calculations for their transformation as well as calculations for statistical analyses should be included in an appendix to be found at the end of the paper.

Tables. Clear, concise data tables help shorten a paper and should provide a convenient method for communicating a wealth of data.

1. Each table should have a number and descriptive legend located above the table. The legend should include a title followed by any other information required to understand the table and an explanation of any symbols used. For example: Table 1. The net productivity of Aiptasia sp. and their symbionts in response to different wavelengths of light.
2. Do not leave blank spaces in the table. If an observation has a zero associated with it, include the zero in the table. If an observation is missing, put a dash (-) in the appropriate square.
3. Any time measured data (e.g. weight, length, etc.) are included, you must indicate the units in metric units. All measured data of a given type (e.g. length or volume) should be expressed in the same units.

Figures. The most common figure you will use is a graph, however diagrams and photographs are also regarded as figures.

1. Each figure should have a number and a legend that makes clear to the reader what is being presented in the figure. The number and legend should be below the figure.
2. The horizontal axis (abscissa) should contain the independent variable and should be properly labeled with the units indicated. The vertical axis (ordinate) should contain the dependent variable and should also be properly labeled.
3. Data are often presented in figures as mean values with plus and minus one standard errors, or, one standard deviation as error bars.

Conclusion / Discussion

This section is for the interpretation of the results of your study. In the discussion, the results are explained and interpreted with respect to the research questions and/or hypotheses that were tested, and with respect to the
procedures that were used in the investigation. When it is appropriate, tables and figures in the Results section should be referred to in the Discussion. In addition, the results are compared to the results of previous studies (which must be properly cited). If the results are contradictory or unexpected, you should attempt to explain why this is the case. You should mention possible sources of error in your procedures if they seem relevant to the interpretation of your results. You should also present your conclusions in this section. Any conclusions stated should be based only on data that were presented in the Results section, although information from other properly cited sources may be used to support the conclusions you make further from your data. Additional questions that should be considered in the Discussion are: Are there further studies that should be done to answer the question? Should the original hypothesis be modified? Do the data suggest other questions and studies that could be addressed?

The discussion should describe the significance of the specific study that you have carried out in comparison to the broader subject in question, but you should avoid reviewing everything you know or can find about the particular subject.

**Sources (Bibliography and Literature Cited)**

Every academic discipline has its own peculiar method of citing reference sources, individuals who have directly helped in the study, etc. Begin the Bibliography section on a separate page. Note that this section contains only literature cited in the paper and not references to other works that you did not directly utilize. In the body of your paper you must cite the author of any previous work or the source of any information to which you would refer. However, you do not footnote at the bottom of the page or at the end of the paper. Instead, you simply give parenthetically the author’s name and the date of the paper at the end of your sentence. Or, you may make the author’s name a part of your sentence by giving the date immediately after it in parentheses. In both cases, the author and date comprise part of the sentence. For example:

There is a considerable delay in maturation of *Crassostrea virginica* living under conditions of seriously depressed salinity (Butler, 1949).

Butler (1949) and Loosanoff (1950) have given clear descriptions of the gonadal changes in *Crassostrea virginica*.

In the text of the paper, notice that the author’s name and the date in parentheses are separated by a comma. Also recognize that more than one citation can be included with a single set of parentheses, e.g., (Enns, 1967; Ward and Robb, 1967; Klocke, 1978). Note the separation by a semicolon. The order within the parentheses should be chronological. If two or more papers in the same year are cited, single author papers are cited first and in alphabetical order.

Then at the end of your paper list the literature cited in alphabetical order, according to the author’s last name. If two or more papers by the same author are cited, the order is chronological. Do not number the references. The literature cited should be listed depending on the type of literature that is cited.

**Acknowledgments**

You may use a few lines in this section to acknowledge funding sources, individuals who have directly helped in the study, etc.

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