

## *Science Research Class Description*

**Welcome!**

You have a challenging mission this semester by taking on a science research project.

The success you experience will rely on self-motivation, persistence, organization and perseverance.

I will help facilitate you through the process.

Of critical importance is that you adhere to the rigid guidelines indicated below.

**Everyone is required to keep a science notebook!!!**

The notebook will be a record of every bit of information you experience during this project. Information like dates, times, phone calls, discussions, data collection, references thoughts/events.....a descriptive diary of all your experiences. When you meet during class, you **MUST** bring you notebook with you to share the work you have been doing.

A rubric will be used to document and grade your progress through the semester. Meeting deadlines, keeping a detailed science notebook, and work submissions are examples of components which will be evaluated on the rubric.

If you are enrolled in this class you **must** dedicate approximately 3-4 hours per week on your project. Entries in your notebook should reflect this.

You will be asked to identify and submit a problem/topic the first week and upon approval you should make every effort to begin work with your proposal.

A brief project description and background information will be due in the next couple of weeks and should reflect the research you envision completing this semester.

I trust you are self-motivated to accept this challenge. Please see me immediately if you have reservations.

**Good Luck!**

Mr. Emmons [dkemmons@hpa.edu](mailto:dkemmons@hpa.edu)

## **Instructions for Preparation of Library Research Papers**

### **Title:**

Long enough to describe your research without any extra words (see page 8 for more help).

### **Introduction:**

- Introduce your subject and explain your reason for writing about it.
- State the main idea or concept of the paper and / or your goals for writing the paper.
- Preview any important points that will support the main idea.
- Provide important background information, and any definitions, so others will understand your topic.
- Why is your topic important?
- Correctly spell and use scientific terms and names of organisms (see page 8 for more help).

Be sure to acknowledge all references and cite your references properly throughout your paper. (See page 8 for more help).

### **Main body:**

This section will give the bulk of information found during your library research. Organize your material in a logical manner and use headings or subheadings to guide the reader through the paper.

- Have two to four main points that support your thesis (main idea).
- Build a focused discussion with your own ideas (do not just regurgitate information).
- Information in the main body should support your thesis.
- Show evidence of understanding the scientific and technical principles of your topic.
- Use data or illustrations to support your main ideas.

### **Summary:**

This is not a conclusion but rather a summary of the main points of your paper.

- Summarize your central idea and supporting main points.
- Create a final impression of your topic, present your viewpoint, or make a call to action.

### **Citations / References (for more detail, see page 8)**

- Cite references within your paper using author-date (Lee, 2000).
- List a reference in the back for each citation in the text.
- Keep your references adequate and appropriate to the topic.
- List references in alphabetical order by author's last name.
- It is recommended that your references contain at least six (6) sources.
- Your sources should not consist mainly of personal communication or internet sites. When possible find the published reference the internet site was based upon.
- When possible, references should contain recent information (four references within the past six years).
- References should follow the correct format, explained on page 8.

### **Acknowledgments**

- Acknowledge those who provided major assistance in your research.

## Instructions for Preparation of Experimental Research Papers

### Title:

Long enough to describe your research without any extra words (see page 8 for more help). Do not write the title as a question. Do not use abbreviations.

### Abstract:

Provide a brief overview of your paper in one or two paragraphs consisting of no more than 175 words (approx. 10-12 lines of text in Times 11-point font).

- State research problem (**introduction**)
- How the problem was studied (**explaining your methods**)
- What was found (**summarizing your results**)
- Summarize the meaning of your results (**discussion and conclusions**)

Do not include subheadings, bibliographic references, figures, or tables. Do not emphasize minor details or include information or conclusions not stated in your paper. Try not to use first person (e.g., "I").

### Introduction

- Clearly state the problem (hypothesis) being investigated.
- Provide background information on the nature and scope of the problem.
- Review the relevant literature. Do not try to include everything you know about the topic. Cite the relevant literature sources in the text.
- Explain your purpose in investigating the problem and why it is significant.
- Correctly spell and use scientific terms and names of organisms (see page 8 for more help).

### Materials and Methods

In paragraph format with complete sentences,

- Identify the important experimental variables and controls,
- Describe how you conducted your study,
- What equipment you used,
- What procedures you followed.

A numbered list of steps is not acceptable. Provide enough details so that the research could be replicated by someone else.

### Results

- Present the results of your research findings in logical order. You should not interpret the results in this section; just present the facts. Also report your findings even if they are not earth-shaking.
- Use visuals (graphs, tables and/or illustrations) as appropriate:
  - Maps / drawings should be in black, not color.

## **Experimental Research Papers continued**

- Photos in black and white
  - All charts, graphs, maps and photos are labeled "figures" and numbered consecutively
  - Captions should be placed below figures
  - Tables should be labeled as "Table" with a consecutive number, and titled appropriately
  - Give credit for illustrations taken from other sources.
  - 3 dimensional graphs can be misleading; stick with 2 dimensional graphs.
- Even if your results are presented in tabular or graphic form, the important highlights should be explained in the text of your report. Tables and figures supplement or complement the text, eliminating lengthy discussions.
  - The results of any statistical analyses performed should also be reported and discussed in this section. Remember to explain the statistical tests used.

## **Discussion and Conclusions**

This section is an analysis of your results. Therefore, you should interpret your results and draw conclusions. Try to build a focused discussion with reasoning and explanation rather than just regurgitating information.

- Relate your results to your original hypothesis.
- Compare your findings with existing research and show how your results and interpretations agree or disagree.
- Draw conclusions based on your data (as reported in the results).
- State the limitations which affect your results and discuss any other factors over which you had no control. Explain how these might have affected the outcome of the study.
- Finish by summarizing the most important points of your investigation.
- Suggest further experiments to continue this project.

## **Citations / References (see page 8)**

- Cite references within your paper using author-date (Lee, 2000).
- List a reference in the back for each citation in the text.
- Keep your references adequate and appropriate to the topic.
- List references in alphabetical order by author's last name.
- It is recommended that your references contain at least six (6) sources.
- Your sources should not consist mainly of personal communication or internet sites. When possible find the published reference the internet site was based upon.
- References should follow the format explained on page 8-9.

## **Acknowledgments**

In one short paragraph state:

- Where and when the research was conducted

## **Rules for Experimental Research**

### **Non-Human Vertebrate Animals**

- Only animals that are lawfully acquired shall be used in experimentation and their retention and use shall be in every case in strict compliance with state and local laws and regulations.
- Animals used in experimentation must be given every consideration for their bodily comfort; they must be kindly treated, properly fed, and their surroundings kept in a sanitary condition.
- No intrusive techniques may be used, including surgery, injections, or taking of blood. In addition, the PS<sup>3</sup> does not permit giving drugs and other chemical agents to measure their effect on animals.
- No changes may be made in the organism's normal environment with the exception of maze running.
- For maze running and other learning or conditional activities, food or water cannot be used or withheld for more than 24 hours.
- When animals are used by students for their education or the advancement of science, such work shall be under the direct supervision of an experienced teacher or investigator.

### **Human Subjects**

- No project may use drugs, food, or beverages in order to measure their effect on a person.
- Projects that involve exercise and its effect on pulse, respiration rate, blood pressure, and so on are approved if a valid normal physical examination is on file and the exercise is not carried to the extreme.
- If your research involves questionnaires or surveys, proper consent from subjects must be obtained.
- If your research involves human subjects and your school has no formal policy regarding such research, please call the Hawaii Academy of Science office.
- No human cultures of any type - mouth, throat, skin, or otherwise will be allowed.
- Tissue cultures purchased from reputable biological supply houses or research facilities are suitable.
- The only human blood that may be used is that which is obtained from a blood bank, hospital, or laboratory. No blood may be drawn by any person or from any person specifically for a science project. This rule does not preclude a student making use of data collected from blood tests not made exclusively for a science project. Blood may not be drawn exclusively for a science project.

## Sample Abstract

### **A Test of the Competitive Exclusion Theory in Two Related Species of Butterflies**

Sarah Dioski

Oil City High School, Grade 11

Sponsoring Teacher: Georgianna Spallanzi

Mentor: Joseph Pascale (Only if applicable)

The food habits of the larval butterflies of two related species *Papilio splendens* and *Papilio blanchi* in a zone of overlap near Oil City, Pennsylvania were examined. The theory of competitive exclusion predicts that food habits of closely related species should not overlap significantly where the species occur together. Transects in five different habitats were used to determine food and habitat preferences in wild populations. Captive caterpillars were offered various foods in the laboratory; weight changes of foods and caterpillars were examined daily. Food habits in overlapping habitats were significantly different between the two species (ANOVA  $p = 0.001$ ). Food habits in non-overlapping habitats were not significantly different (ANOVA  $p = 0.52$ ). There were no differences in food preferences (ANOVA  $p = 0.76$ ) or growth rates (ANOVA  $p = 0.88$ ) on different foods in laboratory populations. These species are able to coexist because they are not competing for the same and limiting food resources in the same area. These results support the theory of competitive exclusion because the two species did not use the same food resources in the same habitats.

## How to Write an Abstract

A properly written abstract presents a summary of the research conducted and the most significant conclusions reached. Abstracts are the chief means by which scientists decide which research reports to read.

### The Title

Make your title concise, but also descriptive.

### The Body of the Abstract

The abstract is a very brief overview of your ENTIRE study. The abstract tells the reader WHAT you did, WHY you did it, HOW you did it, WHAT you found and WHAT it means. The sequence of sentences is ordered in a logical fashion, beginning with an introduction and includes your hypothesis and proceeding to your test (e.g., materials, methods and procedures used), results (data or findings), discussion and conclusions.

Think of the most important items that crystallize each part of your research study. Leave out the unimportant details. As a first draft, write one or two sentences that summarize each section. For your final draft, make sure the abstract flows logically. Give it to a teacher, parent, mentor, friend, etc. to read. Ask them to tell you what they think you actually did and what you found. Revise as necessary.

An abstract is usually one paragraph consisting of about 150-200 words.

## Hints for Writing Research Papers

### 1. Choosing an appropriate title.

A title is a concise identification of the main topic of the paper. It should not be too short or too long. (A two to three word title may be too short, but a 14 or 15 word title is too wordy).

For example:

“Whales” (What about whales?)

“All About Whales” (Can you really tell all about whales in ten pages?)

“The Tale of the Whale” (Too ‘cutesy.’ You need to be more scientific.)

“Similarities and Differences Among All Kinds of Tails in All Kinds of Whales” (Too long. Too much to write about.)

“A Comparison of the Caudal Appendages in the Marine Mammalian Order Cetacea” (Very scientific, but still too wordy.)

“Comparison of Caudal Appendages of Cetacea (Whales)” (At last we have a good title. Give the common name along with the scientific one.) (Thanks to Sr. Edna Demanche)

### 2. Scientific Names / Terms

- Scientific names are italicized with the Genus capitalized and the species lower case, e.g. *Allium sativum*.
- Once you have given the full scientific name, you then refer to it as *A. sativum*.
- Of course, you could also call it by its common name – garlic.
- Scientific names and terms should be correctly spelled and used.

### 3. Citing References in the Text

Virtually all scientific papers rely to some degree on previously published work. When an idea is borrowed (whether directly or paraphrased) from another source, it must be acknowledged in the text and the origin of the information must be revealed.

The formal acknowledgment in the text is called a citation. The citation serves as a link between the text in which it appears and the formal alphabetical list at the end of the paper called References. All citations in the text must appear in the References; likewise, all references in the list must be cited in the text.

When citing in the text, the reference (author and year) should be placed naturally into the flow of the sentence.

- One author: “Pascal and co-workers (1981) first isolated a mutant...”  
“Examination of codon usage predicts ADH to be a highly expressed protein in *E. coli* (Ikemura, 1985).”
- Two co-authors: (Smith and Jones, 1999)
- Three or more co-authors: (Smith et al., 1997)

### 4. Listing References

References must contain certain minimum information. For journals, include author, year of publication, title of article, abbreviated journal name in italics, volume number, and page numbers. For books include author or editor, year of publication, book title (in italics), location of publication and publisher. For sources other than a book or journal, include enough information so that the source can be identified (see Sample References). Arrange the list alphabetically by the first author’s last name.

The following style points should be observed:

- A single-author entry comes before a multi-author entry beginning with the same name.
- Works by the same person are arranged chronologically by date of publication.
- If the name of the author is unknown, list the work alphabetically by the first important word in the title.
- Titles of books and journals are italicized. Titles of articles are not italicized or enclosed in quotations.

## Hints for Writing Research Papers continued

- Locations that are well known for publishing can be listed without a state abbreviation, e.g. Chicago and New York.
- All references are justified on the left margin. If the reference requires more than one line, the additional lines are indented 1/2".
- Double space between references.
- Periods separate major components.
- Colons separate titles from subtitles, cities from publishers, and volumes from pages.

## Sample References

### Book

One author: Day, R.A. 1994. How to write and publish a scientific paper. 4th ed. Phoenix: Oryx Press.

More than one author: Woolston, D.C., P.A. Robinson, and G. Kutzbach. 1988. Effective writing strategies for engineers and scientists. Chelsea, MI: Lewis Publ.

Dictionary , editor: Urdag, L., ed. 1972. Magnet. In The Random House college dictionary. New York: Random House.

### Encyclopedia

With author: Hart, L. W. 1988. Magnet and magnetism. In World Book. Vol. 13. Chicago: World Book.

Editor, no author: Lorimer, L.T., ed. 1993. Magnet and magnetism. In Encyclopedia Americana. Vol. 15. New York: Americana Corp.

Internet: Martin, Linda. 08 Nov 1997. General Information. <<http://www.science.siu.edu/ijsh/info.html>> Accessed 20 Nov 1997.

Interview: Barber, J. D. 8 May 1995. Interview by author. Carbondale, IL.

### Journal Article

One author: Clark, D. P. 1989. The fermentation pathways of *Escherichia coli*. FEMS Microbiol. Rev. 63:223-234.

More than one author, title and subtitle: Kohara, Y., K. Akiyama, and K. Isono. 1987. The physical map of the whole *E. coli* chromosome: application of a new strategy for rapid analysis and sorting of a large genomic library. Cell 50: 495-508.

### Magazine, paginated by issue:

Cowley, G. 23 Jan 1995. HIV's raw aggression. Newsweek. 75 (4): 58.

### Newspaper

No author: Study finds free care used more. May 1989. APA Monitor. 14.

Discontinuous pages: McDonald, K. A. 15 Dec 1995. Researchers ponder a stormy forecast. The Chronicle of Higher Education. A12, A16.

### Pamphlet, organization as author:

American Society for Microbiology. 1994. Slide and poster requirements. Pamphlet. Washington, DC: ASM.

Phone Conversation: Barber, J.D. 8 May 1995. Personal communication.



# Project Categories

## 1) Behavioral and Social Sciences

Human and animal behavior, social and community relationships—psychology, sociology, anthropology, archaeology, ethnology, ethnology, linguistics, learning, perception, urban problems, reading problems, public opinion surveys, educational testing, etc.

## 2) Biochemistry

Chemistry of life processes—molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, etc.

## 3) Botany

Study of plant life—agriculture, agronomy, horticulture, forestry, plant taxonomy, plant physiology, plant pathology, plant genetics, hydroponics, algae, etc.

## 4) Chemistry

Study of nature and composition of matter and laws governing it—physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry, etc.

## 5) Computer Science

Study and development of computer hardware, software engineering, internet networking and communications, graphics (including human interface), simulations/virtual reality or computational science (including data structures, encryption, coding and information theory).

## 6) Earth and Space Sciences

Geology, mineralogy, physiography, oceanography, meteorology, climatology, astronomy, speleology, seismology, geography, etc.

## 7) Engineering

Technology; projects that directly apply scientific principles to manufacturing and practical uses—civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigeration, transportation, environmental engineering, etc.

## 8) Environmental Sciences

Study of pollution (air, water and land) sources and their control; ecology.

## 9) Gerontology (*new category*)

Study of the aging process in living organisms.

## 10) Mathematics

Development of formal logical systems or various numerical and algebraic computations, and the application of these principles—calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability.

## 11) Medicine and Health

Study of diseases and health of humans and animals—dentistry, pharmacology, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, etc.

## 12) Microbiology

Biology of microorganisms—bacteria, virology, protozoology, fungi, bacterial genetics, yeast, etc.

## 13) Physics

Theories, principles, and laws governing energy and the effect of energy on matter—solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.

## 14) Zoology

Study of animals—animal genetics, ornithology, ichthyology, herpetology, entomology, animal ecology, paleontology, cellular physiology, circadian rhythms, animal husbandry, cytology, histology, animal physiology, invertebrate neurophysiology, studies of invertebrates, etc.

*\*-These project categories are the same for the Science Fair.*

Name \_\_\_\_\_

## *Science Research Grading Rubric*

### **1. QUESTIONING**

- 4 My question is clear, well-focused and requires high level thinking skills in order to research.
- 3 My question is clear and well focused. My question requires moderately high level thinking skills.
- 2 My question is incomplete and unclear. My teacher needed to help me form a question.
- 1 I was unable to come up with a research question.

### **2. PLANNING**

- 4 I made really good use of my time. I was able to remain focused on the tasks and make changes when I needed to. I was able to develop a clear method to organize my information. I was able to make revisions in my plan when needed.
- 3 I was able to work within the time frame my teacher gave me. I was able to develop a system to organize my information. I was able to make revisions with help from my teacher.
- 2 I needed teacher help to list and organize what I needed to do. There are some steps missing in my planning. I made revisions with teacher help.
- 1 I was unable to come up with an organized plan and work within the time limits.

### **3. GATHERING**

- 4 I used a variety of resources and carefully selected only the information that answered my question. I was able to continually revise my search based on information I found.
- 3 I used many resources to find information that answered my question. I tried at revising my search, but had some problems doing so.
- 2 I used 1 or more sources. Original question or focus guided my search, although I should have made revisions. I made errors in selection of references.
- 1 I lost focus during the gathering process and therefore my information was not accurate and complete.

#### 4. SORTING

- 4 I thoroughly selected and organized information that answered my question in a organized way. I selected information that was appropriate.
- 3 I sorted information and organized information that answered my question without too many errors.
- 2 I tried to organize the information I found, but I made some mistakes. I wasn't able to completely stay focused on information that would answer my question.
- 1 I was unable to sort and organize the information I found to answer my question.

#### 5. SYNTHESIZING

- 4 I used the information I found in a meaningful way to create an original product that clearly answers the question with accuracy, detail and understanding.
- 3 My product answers the question in a way that reflects learning using some detail and accuracy.
- 2 My product is not complete and only answers part of the question.
- 1 My product is incomplete and contains missing details and it isn't completely accurate.

#### 6. DEADLINES

	Problem Statement 9/01/06	Materials and Methods 9/21/06	Results/ Observations 11/01/06	Abstract 11/22/06	Rough Draft 12/01/06	Final Draft 12/08/06
Met deadline on time						
one day late submission						
Two or more days late submission						
Never submitted						

## Science Research Schedule and Contact Information Form

Name \_\_\_\_\_

Proposed Topic (if known) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

### My contact information

email: \_\_\_\_\_

home phone: \_\_\_\_\_ (optional)

cell phone: \_\_\_\_\_ (optional)

### My current class schedule

A period: \_\_\_\_\_

B period: \_\_\_\_\_

C period: \_\_\_\_\_

D period: \_\_\_\_\_

E period: \_\_\_\_\_

F period: \_\_\_\_\_

**Mr. Emmons can be reached at:**

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**885-6162 home**

**895-9586 cell**