DEAD OR ALIVE?

A Preliminary Analysis of Unknowns for Evidence of Life Forms

OVERVIEW

This lab is designed to give you some experience with the overall research process. Research costs time and money. Often preliminary data must be collected to establish trends and define the experimental system. In this particular lab, you are asked to determine which samples collected from various areas in a deep oceanic trench, are most likely to contain evidence of life forms. You are not asked to definitively identify each sample. The exercise involves developing operational definitions of alive, dead, organic and inorganic to use in developing your protocol, writing a grant proposal and develop a budget for the proposed research.

In the scenario presented, each lab is "competing" for the government contract to analyze the thousands of grab samples that were taken from the different areas of the deep trench. To determine which lab will receive the contract (and the funding) the government has provided each of the labs which have applied with a small subset of the samples. The contract will go to the lab which develops the most cost effective and accurate methodology for determining which of the samples contain evidence of life.

BEFORE COMING TO LAB

1. Read the sections in a general biology text which:
   a) provide a definition of "life" and
   b) describe the basic chemical compounds and reactions which are characteristic of all living things.

2. Read all of this lab titled "Dead or Alive."

3. Answer the Pre-Lab questions.

4. Complete the "Biology 151 Searching the Web Tutorial" at the following web site:
   http://www.library.wisc.edu/libraries/Steenbock/bipage/present.htm
   Select the link for "Biology 151 Searching the Web Tutorial". (Time to complete = 30 to 45 min.)
   Print out a copy of the web quiz to hand in at the beginning of lab, week 1.

PRE-LAB QUESTIONS - Week 1

1. Based on your reading, list the basic characteristics of life below.

2. What characteristics would you look for to determine if a specimen was once alive and is now dead? List these below.

3. Define inorganic and organic.

4. List below characteristics that would easily allow you to separate organic from inorganic compounds.

5. Are the following organic or inorganic? In your answers consider the difference between an element and a compound.

a) pure carbon powder
b) a diamond
c) the calcium carbonate deposits (e.g., White Cliffs of Dover) formed from the remains of ancient marine organisms,
d) methane (CH_4),
e) ethanol (CH_3CH_2OH).

PRE-LAB QUESTIONS WEEK 3: INTERNET SEARCHING EXERCISE

A. Complete the "Biology 151 Searching the Web Tutorial" at following web site:
http//www.library.wisc.edu/libraries/Steenbock/bipage/present.htm

B. After you have completed the web tutorial, use the Web to search for additional information on life in deep trench environments, NSF proposal requirements or definitions of alive, dead, organic and inorganic.

Your search must include at least two concepts and the use of two alternative terms. Example: (cats or feline) and nutrition

C. After completing the web search for additional information related to this lab exercise answer the following questions.

1. Which search engine(s) did you use (Alta Vista, Lycos, etc.)?

2. What is the wildcard or truncation symbol in your search engine?

3. How is a multi-word phrase typed in your search engine?

4. What advanced search features of your search engine did you take advantage of ? E.g., ranking, use of near operator, etc.)

5. Title of one web document or site found and URL:

6. Who is responsible for this information? (person, agency, etc.)

7. Based on the evaluative criteria discussed in class, is your web document or site a good one? Explain.

8. What information is available at this web site?

9. How could this information be of value to the researchers trying to write a proposal to win the contract for analysis of deep trench samples? Explain.

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Notes on Internet Searching Strategies

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WHAT IS THE RESEARCH PROJECT?

A major US oceanographic survey has just discovered entirely new forms of life in one of the deep oceanic trenches. This discovery led the survey team to take thousands of grab samples from nearby areas to determine if they provide evidence for more forms of life. These samples now need to be analyzed. Doing a complete analysis of each sample would be prohibitively expensive and time consuming. Therefore, the first step is to determine which of the thousands of samples are most worthy of complete study and analysis.

The National Science Foundation, a granting agency of the government, plans to give the multimillion dollar contract for the complete analysis to one major research lab. To determine which lab gets the contract, the NSF has provided competing labs with subsets of the samples. The lab that gets the contract will be the one that develops the most cost effective and accurate methodology to determine which of the thousands of samples are most worthy of complete study and analysis. The protocol for determining which samples are most likely to contain evidence of life forms has been left up to the competing labs.

Your lab has requested and received one of the subsets of samples. If you get the contract, you will be able to support yourself and your employees for several years. In addition, the national recognition the contract provides will help your lab gain future contracts. You call a lab meeting to brainstorm how to determine which samples are "most likely to contain evidence of life forms." Your staff, time and budget are limited.

Before you begin, you will need to:

A. Define alive, dead, organic and inorganic and develop operational definitions of each of these that can be used in experimentation. Your operational definitions will obviously be limited by the methods you will use.

B. Determine what test(s) you would need to develop to determine if something is:

1. Alive
2. Once alive, but now dead
3. Never alive and not formed by something once alive

C. Determine how many tests are needed in each case.

D. Decide how you could most efficiently organize your team of scientists for this initial investigation.

Keep in mind, you need to define and justify all of these in your proposal to the granting agency.

II. WHAT PRELIMINARY RESEARCH DO WE NEED TO DO?

How do we develop operational definitions and an experimental design?

A. You will be assigned to research groups of 3 or 4 to compare your responses to the Pre-Lab Questions 1 to 5.

You should develop group consensus responses to these Pre-lab questions. Write these responses in your lab notebook.

B. Define alive, dead, organic and inorganic and develop operational definitions of each of these that can be used in experimentation.

Your operational definitions will obviously be limited by the methods you will use. Again come to a group consensus on this. Write these responses in your lab notebook.

C. Using your subset of specimens:

1. Determine what types of tests need to be performed to determine if the samples contain specimens which are alive or dead, etc.
2. Include consideration of what controls, if any, will be needed for each test.
3. Determine what types of supplies and equipment you will need to perform the tests.
4. Determine what further information you will need.
5. Indicate how the work will be subdivided among your team of scientists.

D. Write a proposal describing your preliminary research plan. This should include:

1. An introductory statement which explains the purpose of your experiment. (Refer to Appendix A and the Sample Paper in the front of your lab manual.)
2. A materials and methods section that describes your experimental design. Include a flow diagram of procedures to be followed.
3. A separate sheet that contains a list of supplies and equipment needed.

E. Compare your introduction, materials and methods sections and equipment list with that of another group.

Offer each other constructive criticism or suggestions for improvement. Modify your work as needed based on the discussion. Save the comments given to your group by your peers and attach them to your lab report.

F. At the end of lab, be prepared to hand in the work completed in A through E.

III. HOW DO WE CONDUCT THE PRELIMINARY RESEARCH? – Week 2

A. Your instructor will provide you with review comments on your preliminary research proposals, including lists of supplies and equipment, overall format and style and experimental design.

1. Look these over and discuss them within your group.
2. Revise your proposal as needed based on your discussion.

B. Your instructor will then demonstrate the correct procedures for use of various supplies and equipment.

C. Your group should:

1. Discuss any questions about review comments with your lab instructor.
2. Set up the supplies and equipment needed for the preliminary tests you proposed.
3. Conduct the tests.
4. Record the results of the tests for each specimen.
5. Assign responsibility for the preliminary drafts and data analysis that need to be done before coming to lab week 3.

Assign different members of your group to:

a. Write a first draft final Introduction for your proposal to NSF.

b. Do the data analysis and write up the results your group obtained for its subset of samples. Indicate which tests were performed, why these were selected and what the results of the tests were for each sample.

If there are 4 group members, two should do 5a. and to should do 5b.
If there are only 3 members in your group, two should do 5a and one should do 5b.

Each group member should bring both an electronic copy and 3 printed copies of his/her draft to lab, week 3.

During week 3, the entire group will review and revise these and prepare the final proposal to NSF.

Be sure to review sections IV and V of this lab exercise before coming to lab week 3.

E. Use the following cost estimates to develop the budget for you proposed research.

1. Brief microscopic examination (unstained/unfixed) - $5/slide

2. On-slide stains/fixatives plus a brief visual exam - $6/slide

3. Feulgen staining and brief microscopic exam - $8/test

4. Benedict's test - $5/test

5. Biuret test - $5/test

6. Detailed examination of stained or unstained material on slide, includes photo or sketch - $15/exam

7. Burning - $15/test
   Replacement Crucible - $5
   Replacement Cover - $3

8. Agar plating, 48 hr culture, and brief examination - $7/test plate

9. Detailed analysis of plates with growth - $20/plate

10. Tetrazolium test - $5/test

11. Starch test - $2/test

12. Fat/oil test - $2/test

13. Water solvent test - $3/test

14. For unlisted tests:
   Add on a charge for test materials at:
      stains $1/test
      agar plates $2/plate
      solvents $1/test tube
   Add on $1/test to cover costs of:
      cleaning recyclable materials, e.g., test tubes, pipettes
      non-recyclable test tubes, plates, "dispo-pipettes," etc

15. Charge your time at $20/hr/person and add $10/hr/person for overhead costs (heat, electricity, building maintenance, employee health insurance, administrative staff and other service., e.g. xeroxing, secretarial support). Add another $5/hr/person profit (which will be held in reserve for replacing broken equipment, buying new equipment and expanding the business, etc.)

IV. HOW DO WE USE THE RESULTS FROM OUR PRELIMINARY RESEARCH? - Week 3

In this study, you are assuming that the class is a research lab working together to get the contract for further analysis of the deep trench data. Whether or not you get the contract depends on how well the lab does as a whole. Therefore, it is in everyone's interest that each of the proposals be as good as possible. To assist each other in this regard, individual teams will :

- report the results of their analyses of samples.
- share ideas as on what should be contained in each section of the final proposal to NSF.

A. Complete testing as necessary.

This week you should finish any tests you feel you need to perform.

B. Report the results of testing.

At the beginning of the lab, each group should log their test results on the overhead provided by the instructor. Once all data are logged, each group will discuss the tests they performed, why they selected these tests and what results they obtained.

C. Share ideas on how to structure your final proposal to NSF.

You should work together in small groups for about 10 minutes to discuss what should be contained in each of the sections of your final proposal. Refer to the information on how to communicate your findings and NSF proposal requirements when doing this (Sections IV and V).

Your lab director/instructor will then ask groups to share the type(s) of information they feel should be included in each section.

D. Write your final proposal to NSF.

See "V. HOW DO WE COMMUNICATE OUR FINDINGS?
What form does NSF require?" for instructions on the format and information that will be required in your final proposal.

Final proposals are due as indicated by your lab director/instructor.

V. HOW DO WE COMMUNICATE OUR FINDINGS? What form does NSF require?

After you have completed your experiment and analyzed your preliminary data, you should prepare your final proposal to NSF.

Before you begin:

1. Review the preface section titled: "Writing Group Lab Reports."

2. Refer to Appendix A on "How Scientific Papers are Structured" for more complete information on writing the various sections of a scientific paper.

3. Review the NSF Requirements for Proposal Submission outlined below. Proposals that do not meet these requirements will not be considered in the grant competition.

NSF REQUIREMENTS FOR PROPOSAL SUBMISSION

Proposals shall be no longer than 6 pages in length (not including references, budget sheet, tables and figures).

Pages must be numbered.

All papers must be typed in 12 point font (Times New Roman preferred) and double spaced between lines of text.

Margins must be one inch (left, right, top and bottom).

All tables and figures must be numbered and referred to in the body of the proposal.

All tables and figures must have appropriate titles and captions or legends.

The information in the proposals must be organized as outlined in the Sample Proposal Format below.

Proposals are due no later than _____.

Proposals received after this date will not be accepted for review.

SAMPLE PROPOSAL FORMAT

Lab name
Address
City, State Zip code

Proposal submitted to:
National Science Foundation
Box 000
Washington, D.C. 00000

Principal Investigators names:

Title

(The title should be descriptive of the rationale and results of the study.)

Introduction

- Indicate the purpose of the proposal. What are you proposing to do?
- Indicate the rationale behind your proposal. Why is this necessary or important?

Preliminary Analysis of a Subset of Samples

- Identify the specimens tested (include **all** specimens tested by all groups in your lab)
- Summarize the results of your preliminary testing. What do the results indicate. For example, can you use the results to estimate the percentage of the samples that are alive vs dead, organic vs inorganic?

Proposal for Analysis of the Remaining Samples

Materials and Methods

- Indicate the operational definitions you plan to use for alive versus dead, etc. and what, if any, assumptions you plan to make in conducting the analysis.
- Provide a general summary description of the test(s) you plan to perform to determine if the specimens are dead or alive, etc. This text must be accompanied by a finalized procedural flow diagram.
- Include a discussion of any controls needed, as well as, when and why they will be needed.

Results

- Indicate how you will analyze the results of the procedures proposed.

Discussion

- Indicate any recommendations you might make for future study of the specimens based on analysis of your results.

Budget

- Detail the costs associated the protocol proposed. Formally state any assumptions you made in making the estimates. Using these estimates, indicate what it would cost the government for your lab to do the remaining preliminary analysis of the 10,000 samples.

References

- If you cited any references include the complete reference citations here.

Tables and Figures

- Group all tables and figures after the References section.

Appendix

The appendix should contain the following in this order:

- your original week 1 proposal and all review comments.
- your preliminary rough drafts of final proposal sections which were due at the beginning of lab week 3.
- your copy of the overhead of all class data. Be sure to highlight your group's data on this sheet.