Faculty of Science

Laboratory Manual

Biodiversity & Taxanomy

Bachelor of Biotechnology (Hons.)

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Biodiversity & Taxonomy

Table of Content

LINCOLN UNIVERSITY COLLEGE
FACULTY OF SCIENCE (DEPARTMENT OF BIOTECHNOLOGY)
LABORATORY SAFETY RULES

The following rules must be obeyed by all students in the science laboratory of the faculty. Wilful or repeated in advertent non-compliance may result in dismissal or suspension from the laboratories

- No entry without permission:
  - Outsiders are not allowed to enter the laboratory without permission.
  - No student is allowed to enter the laboratory unless permission has been given by a laboratory assistant or a lecturer.

- At work in the laboratory:
  - No experiment may be attempted without the knowledge and permission of a lecturer.
  - Students must wear shoes in the laboratory. Students wearing slippers or sandals are not allowed to work in the laboratory.
  - Lab coat must be worn at all times during practical work in the laboratory.
  - Do not mouth pipette chemicals.
  - Do not eat or smoke in the laboratory.
  - Do not taste any chemicals, including dilute solutions. If any acid or alkali accidentally enters your eyes or mouth, wash immediately with plenty of tap water. Inform your lecturer, and seek medical attention if necessary.
  - Paper should be used to light up the Bunsen burners.
  - Used match sticks, filter papers, and other solid waste must never be thrown into the sinks. They must be thrown into the dustbins provided. Lighted match sticks and smoldering materials must be extinguished with tap water before thrown in to the dustbins.
  - Any equipment broken or damaged must be reported to the laboratory assistant.

- Before leaving the laboratory:
  - All the equipment and benches must be cleaned at the end of each practical session.
  - Wash hands and arms with soap and water before leaving the laboratory.
  - No student is allowed to take away any chemicals, equipment or other property of the laboratory.

INTRODUCTION

1. The Scientific Method

- Making observations
- Generating hypotheses
- Making predictions
- Designing and carrying out experiments
- Constructing scientific models

2. Practical Exercises

To get the most out of the practical exercises, you need to follow carefully the instructions given. These instructions have been designed to provide you with the experience in the following skills:

- Following instructors
- Handling apparatus
- Having due regard for safely
- Making accurate observations
- Recording results in an appropriate form
- Presenting quantitative results
- Drawing conclusions

3. Following Instructions

Instructions are provided in the order in which you need to carry them out. We would advise that before carrying out the instructions, you read through the entire exercise. This will help you to remember what you have learned.

Each practical exercise in the book begins with a few lines describing its purpose in most cases the following headings are also used:

- Procedure-numbered steps that need to be carried out.
- For consideration -some questions to help you think carefully about the results you have obtained.
- Materials-a list of the apparatus, chemicals and biological materials you need.

4. Handling apparatus

Biologists need to able to use many different types of apparatus, for example, photometers (to measure water uptake by plants), respirometers (to measure oxygen uptake or carbon dioxide production), Petri dishes (for plating out bacteria and other microorganisms) and the light microscope (to magnify specimens). Many of the practical exercises are designed to help you derive the maximum benefit from a piece of apparatus.

5. Having Due Regard for Safety

Surveys have been shown that science laboratories are among the safest places to be. Nevertheless, this is no cause for complacency.

- Always move slowly and carefully in a laboratory.
- Never put your fingers in your mouth or eyes after using chemicals or touching biological specimens until you have washed your hands thoroughly with soap and warm water, and dried them.
- Make sure glass objects (e.g, thermometers, beakers) cannot roll off tables or be knocked onto the floor.
- Wear safely goggles whenever there is a risk of damage to the eyes.

<u>Situations of risk include:</u>

- Heating anything with a Bunsen burner (even heating water has its dangers')
- Handling many liquids, particularly those identified as corrosive, irritant, toxic or harmful

- Handling corrosive or irritant solids
- Some dissection work
- Allow Bunsen burners, tripods, gauzez and beakers to cool down before handling them.
- Never allow your own body fluids (especially blood and saliva) to come into contact with someone else, or theirs into contact with you.
- Keep long hair tied back and do not wear dangly earrings.
- Do not allow electrical equipment to come into contact with water.
- If you are unsure how to carry out a scientific procedure, ask.
- Make sure you understand why you are going to do something before you do it.
- Wear a lab coat when using chemicals or handling any biological specimens.
- Follow exactly agreed procedures with regard to cuts, burns, electric shocks and other accidents (e.g. with chemicals).
- Follow exactly all specific safely instructions given in this book or provided by your teacher for particular practical exercises (e.g. use of gloves, disinfection)

With practice, these procedures should become second nature to you. They will enable you to carry out practical work in safety.

6. Making Accurate Observations

In most cases the practical exercise will make it clear what you need to observe, e.g. the time taken for a certain volume of gas to be evolved or the width of a sample cells. Ensure that you know how to use any necessary equipment before starting practical. Think carefully about the precision with which you will make your observations.

7. Recording Results in an Appropriate Form

Results can be recorded in various ways. Often it is helpful to record raw data in a table. Most data will be in the form of numbers, i.e. they will be quantitative data (also known as numerical data). However, some data, e.g. flower colour, will be qualitative data.

One form in which some biological findings can be recorded is a drawing. You don't need to be professional artist to make worthwhile biological drawings. If you follow the following guidelines, a drawing can be of considerable biological value:

- Ensure that your completed drawing will cover at least a third of A4 page.
- Plan your drawing so that the various parts are is proportion and will not be drawn too small. Small marks to indicate the length and breadth of the drawing are a great help in planning and a faint outline can be rapidly drawn to show the relative positions of the parts.
- The final drawing should be made with clean, firm lines using a sharp HB pencil and, if needed, a good quality eraser (not a fluid).If important details are too small to be shown in proportion, they can be put in an enlarged drawing at the side of the main drawing.
- Avoid shading and the use of colour unless you are an excellent artist and they really help, for example when drawing soil profiles.
- When drawing structures seen with the naked eye or hand lens, use two lines to delineate such things as blood vessels and petioles. This will help you to indicate the relative widths of such structures.
- When drawing low power plan drawings from the light microscope, do not attempt to draw individual cells-just different tissues.
- When drawing plant cells at high power under the light microscope, use two lines to indicate the width of cell walls, but a single line to indicate a membrane.
- Always put a scale on each drawing.

8. Presenting Quantitative Results

Presentation of data is all about using graphs or other visual means to make it easier to see what your results tell you. The following four ways of presenting data are the most frequently used in biology: line graphs, bar charts, histograms and scatter graphs (Figure 1).

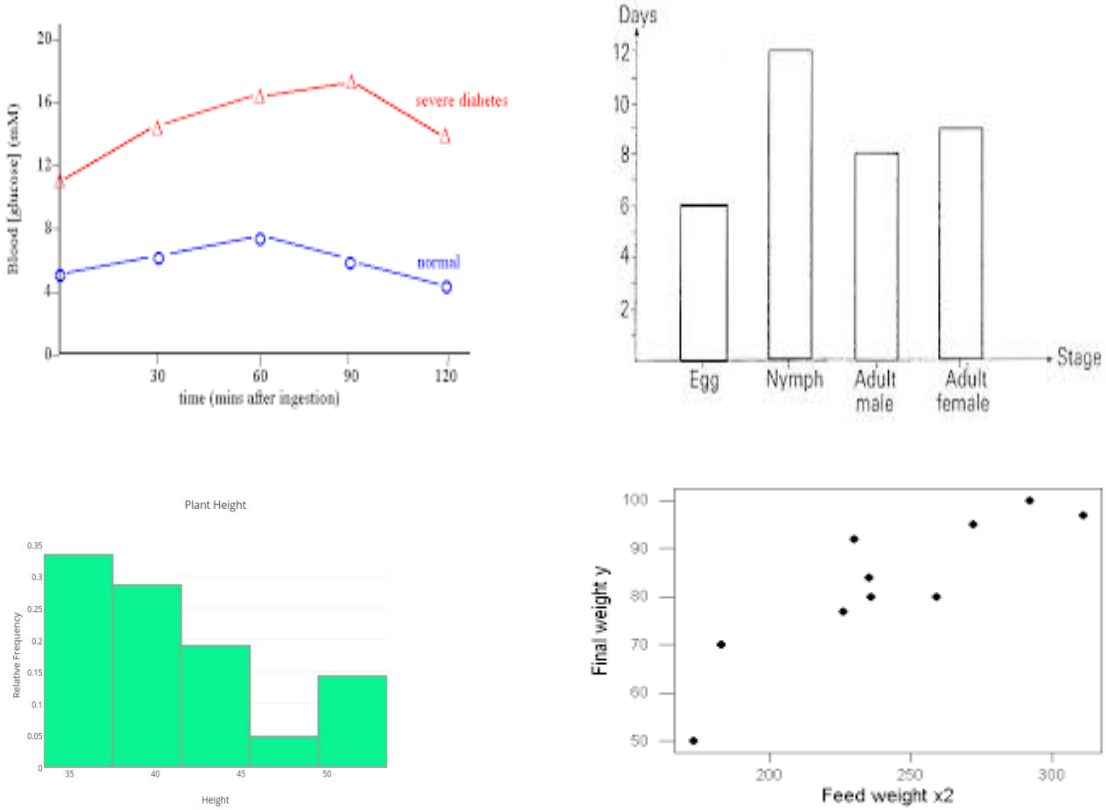

Figure 1: Line graphs, bar charts, histograms and scatter graphs

9. Drawing Conclusions

Finally, you will need to draw conclusions. If your practical exercise has involved the testing of a hypothesis, for example that the enzyme pepsin works better at low pH than in neutral or alkaline conditions, your conclusion should indicate whether the hypothesis has been refuted (i.e. shown not to be the case) or supported. Of course, even if your hypothesis has been supported, it doesn't mean that it has been confirmed with 100% certainty- in other words it isn't proved. Science proceeds more by showing that certain ideas are wrong than by showing that others are right (think about that!). Your conclusion might therefore include further ways of testing the original hypothesis, or might raise new possibilities to be investigated.

Often you will only be able to arrive at your conclusions after statistically analysing your data.

10. Writing a Scientific Lab Report

Title

- Communicate the subject investigated in the paper.

Introduction

- State the hypothesis.
- Give well-defined reasons for making the hypothesis.
- Explain the biological basis of the experiment.
- Cite sources to substantiate background information.

- Explain how the method used will produce information relevant to your hypothesis.
- State a prediction based on your hypothesis. (If the hypotheis is supported, then the results will be.)

Materials and Methods

- Use the appropriate style.
- Give enough detail so the reader could duplicate your experiment
- State the control treatment, replication and standardized variables that were used.

Results

- Summarize the data (do not include raw data).
- Present the data in an appropriate format (table or graph).
- Present tables and figures neatly so they are easily read.
- Label the axes of each graph completely.
- Give units of measurement where appropriate.
- Write a descriptive caption for each table and figure.
- Include a short paragraph pointing out important results but do not interpret the data.

Discussion

- State whether the hypothesis was supported or proven false by the results, or else state that the results were inconclusive.
- Cite specific results that support your conclusions.
- Give the reasoning for your conclusions.
- Demonstrate that you understand the biological meaning of your results.
- Compare the results, with your predictions and explain any unexpected results.
- Compare the results to other research or information available to you.
- Discuss any weaknesses in your experimental design or problems with the execution of the experiment.
- Discuss how you might extend or improve your experiment.

Conclusion

- Restate your conclusion.
- Restate important results.

Literature Cited

- Use the proper citation form in the text.
- Use proper citation form in the Literature Cited section.
- Refer in the text to any source listed in this section.

Acknowledgement

- State any appropriate acknowledgement that you think is necessary.

Practical 1

Title: Assessment of water quality parameters in the nearby water body (Kelana Jaya Lake) in relation to assessment of biodiversity parameters

Objective:

After completing the practical, you will be able:

1. To determine the purity, hardness and nitrate level of water bodies (Kelana Jaya Lake) in order to assess the biodiversity parameters

Introduction:

Water quality testing is an important part of environmental monitoring. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well. These properties can be physical, chemical or biological factors. Physical properties of water quality include temperature and turbidity. Chemical characteristics involve parameters such as pH and dissolved oxygen. Biological indicators of water quality include algae and phytoplankton. These parameters are relevant not only to surface water studies of the ocean, lakes and rivers, but to groundwater and industrial processes as well. Water quality monitoring can help researchers predict and learn from natural processes in the environment and determine human impacts on an ecosystem. These measurement efforts can also assist in restoration projects or ensure environmental standards are being met.

Procedure:

250 ml of sample water was taken from Kelana Jaya Lake

Determine the purity of water

1. A 50 ml beaker was rinsed thoroughly and several times with normal water and filled with sample water.
2. By using a litmus paper, the pH of the water can be determined either its acid or alkali.

Determine the hardness of water

1. The tube from PRODAC test kit was rinsed thoroughly several times with normal water and then added with 5ml of sample water.
2. The reagent was added drop by drop and accordingly each drop was counted until the colour changes from light yellow to red purple.
3. Once the colour changes red purple, the sample was allowed to stand for 1 minute and if the colour disappear more drops of reagent will be added until the colour of sample stays.
4. Temporary water hardness is given in terms of, °dkh. Each degree of reagent drop corresponds the degree of hardness of water that I to obtain the red purple colour.

Determine the nitrate level in freshwater ecosystem

1. The tube from NITRATE test kit was rinsed thoroughly several times with normal water and then added with 5ml of sample water.
2. Ten drops of nitrate test solution was added from bottle 1 and mixed thoroughly which later repeated with 10 drops of nitrate test solution from bottle 2.
3. The tube was kept for 1 minute. After that wait 5 minutes for the colour to develop and the colour changes will be tallied with the colour strip provided in the kit.

Results:

Questions:

1. What is biodiversity?
2. What are the parameters that contribute to the permanent hardness?
3. How can you differentiate permanent and temporary hardness?

Practical 2

Title: Assessment of water quality parameters in the nearby water body (Kelana Jaya Lake) in relation to assessment of biodiversity parameters

Objective:

After completing the practical, you will be able:

1. To learn and differentiate the difference between terrestrial and aquatic ecosystem and requirement of species to differentiate them

Introduction:

Biodiversity is the variety of life. It can be studied on many levels. At the highest level, people can look at all the different species on the entire Earth. On a much smaller scale, people are able to study biodiversity within a pond ecosystem or a neighbourhood park. Identifying and understanding the relationships between all the lives on Earth are some of the greatest challenges in science. Most people recognize biodiversity by species. A species is a group of living organism that can interbreed. Examples of species include blue whales, white-tailed deer, white pine trees, sunflowers and microscopic bacteria that are not able to be seen with naked eye. Biodiversity includes the full range of species that live in an area.

Procedure:

1. A visit to the Kelana Jaya lake site was taken place to observe the ecosystem and identify any species either it is terrestrial or aquatic.
2. Every invertebrate species observable was listed and later searched for its scientific name and additional info regarding that organism.
3. Classification between these species are made by the location or ecosystem it living in which are terrestrial or on/in the lake (includes the banks of the lake and jetty).

Results:

Questions:

1. What do you mean by terrestrial ecosystem?
2. What do you mean by aquatic ecosystem?

Practical 3

Title: Assessment of biodiversity in & around water bodies (Kelana Jaya Lake) in conjunction with human interaction

Objective:

After completing the practical, you will be able:

1. To learn and identify the species found and its interaction among species and the influence of human interaction

Introduction:

An ecological community is defined as a group of actually or potentially interacting species living in the same place. A community is bound together by the network of influences that species have on one another. Inherent in this view is the notion that whatever affects one species also affects many others: the "balance of nature". We build an understanding of communities by examining the two-way, and then the multi-way, interactions involving pairs of species or many species.

Food webs are graphical depictions of the interconnections among species based on energy flow. Energy enters this biological web of life at the bottom of the diagram, through the photosynthetic fixation of carbon by green plants. Many food webs also gain energy inputs through the decomposition of organic matter, such as decomposing leaves on the forest floor, aided by microbes. River food webs in forested headwater streams are good examples of this.

Energy moves from lower to higher trophic (feeding) levels by consumption: herbivores consumes plants, predators consume herbivores, and may in turn be eaten by top predators. Some species feed at more than one tropic level, hence are termed omnivores.

Procedure:

1. A visit to the Kelana Jaya lake site was taken place to observe the species found around the area.
2. Any species from microbes to animals was enlisted this includes species in the lake like fish and algae.
3. From the listed species, a food chain was created to identify their interaction of prey-predator. A food web was also made from combining some food chain of the species found in the lake.
4. Based on the food web and food chain, a few factors were looked into to identify the effects of human interaction that might disrupt and changes the species interaction or their ecosystem.

Results:

Questions:

1. What is species diversity?
2. How can you interpret human influence on species diversity?

Practical 4

Title: Constriction of food chain and food web in forest ecosystem

Objective:

After completing the practical, you will be able:

1. To learn and design the food chain and food web based on the species found in a forest ecosystem

Introduction:

Food web is an important ecological concept. Basically, food web represents feeding relationships within a community. It also implies the transfer of food energy from its source in plants through herbivores to carnivores. Normally, food webs consist of a number of food chains meshed together. Each food chain is a descriptive diagram including a series of arrows, each pointing from one species to another, representing the flow of food energy from one feeding group of organisms to another.

There are two types of food chains: the grazing food chain, beginning with autotrophs, and the detrital food chain, beginning with dead organic matter. In a grazing food chain, energy and nutrients move from plants to the herbivores consuming them, and to the carnivores or omnivores preying upon the herbivores. In a detrital food chain, dead organic matter of plants and animals is broken down by decomposers, e.g., bacteria and fungi, and moves to detritivores and then carnivores.

Food web offers an important tool for investigating the ecological interactions that define energy flows and predator-prey relationship. The idea to apply the food chains to ecology and to analyze its consequences was first proposed by Charles Elton. In 1927, he recognized that the length of these food chains was mostly limited to 4 or 5 links and the food chains were not isolated, but hooked together into food webs (which he called "food cycles"). The feeding interactions represented by the food web may have profound effects on species richness of community, and ecosystem productivity and stability.

Procedure:

1. Students were given time to research regarding the definition of food chain and food web.
2. Food chain can be defined as a hierarchical series of organisms each dependent on the next as a source of food.
3. Food web, on the other hand, is a system of interlocking and interdependent food chains.
4. Based on the forest ecosystem in Malaysia, students were assigned to list the possible found species in the nearby places.
5. From the list, food chains were constructed and from the food chains a food web also was constructed.

Results:

Questions:

1. Describe food chain.
2. Describe food web.
3. Draw the importance of interaction of food chain and food web.

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