Investigatory Project Work

Investigations are more open-ended than practical exercises involving a search to understand the unknown and begins with a question or a hypothesis. You are not instructed exactly what to do, but are given only general guidance. These give you more opportunity to plan your work. For example, you might investigate what traits you and your classmates inherit from your parents and forefathers (both maternal and paternal).

Projects are even more open-ended than investigations. These are practical investigations carried out by an individual or a group of students. Projects are largely your own initiative. It also requires evaluation of your findings, redefining ideas and designing further investigations. This may lead to evidence that enables answering the question posed at the outset. Some of these projects would take about few hours to complete. Other may take few weeks. Some are laboratory based, others involve fieldwork. Many could be carried out at home.

Investigatory projects are part of obligatory assignment involving purely experimental procedures so that you report on, duplicate, or adapt something that someone else has already discovered. It may involve some other form of investigation also. For example, you may undertake to investigate the richness and patterns of biodiversity (flora and fauna) in your school campus and prepare a mural of it or to investigate the effects of physical fitness on your pulse rate.

Choosing an Investigatory Project

You may be guided by your teacher for your choice of topic. The more original or new the project is, the better it would be. But it must be realistic in terms of the time available and at a level attained in the higher secondary biology.

You must review the available literature to find out what type of work has been done. This will help you to reject some of the alternatives, and possibly cause you to modify others. It may also be the source of new ideas.

By doing these investigatory projects you will gain experience of research besides providing opportunity for learning skills such as photography, electronics, etc.

Identifying the Objectives of the Project

Having identified a possible project, you should be able to identify and list the tentative objectives you hope to attain by completing that investigation. For example,

- Suppose your project involves studying the biodiversity of birds in your district/state, examine the data in the light of some questions (say, how do the birds in Rajasthan differ from those in Assam or Bihar?) your investigation might attempt to answer.
- Suppose your project involves investigating leaf mosaics revealing the complexity of the growth correlations that lead to efficient light interception, suggest also the factors that might affect this type of study.

Keep the aim of your project simple. Investigate only one factor at a time and never allow yourself to be side-tracked. Remember that time may be too short for follow-up and any fascinating secondary aspects that you may come across.

Designing Projects

Having established the objectives of your chosen project, you must have an experimental design. This will allow you to collect the data you need in a scientific way to test the hypothesis. For example, if your project involves investigating the hypothesis that stale milk contains more bacteria than fresh milk, devise the procedure you would adopt to carry out your investigation.

Planning Investigations

Having decided your topic for scientific investigation, you should give careful thought to the plan of your investigation in some detail. These may include

- What hypothesis can you make?
- How can you ensure that the experimental tests and measurement you carry out are accurate and reliable?
- What controls do you need?
- How many variables are you investigating? Correctly identify key variables as independent and dependent.
- Are your variables discrete or continuous?
- Identify appropriate control variable for fair test.
- How many repeat observations or samples will you require?
- What instruments/equipment or techniques will you use to obtain relevant information? Identify suitable materials and equipment to be used.
- If your investigation requires the use of a questionnaire, design and standardise before implementation.
- Is your intended procedure safe and ethically permitted, i.e., taking care of the distress or suffering of living organisms and damage to the environment?
- How will you collect your data?

- How do you plan to analyse your results? Would you employ statistical or other methods? Are scale range, interval, number of values chosen are adequate and reasonable ?

Executing the Project

Following planning, a brief description of the expected procedures has to be approved in advance by the teacher. Having decided what controls you need to use, list the components of your experiment and decide what quantities of substances to use, how to set the experiment. You should also decide what type of readings or measurements you are going to make, how often and how many. Note the source of error, if any, that you come across.

- Handle instruments and equipments appropriately to give accuracy.
- Repeat measurement.
- Keep proper controls and the variables constant.

Reporting/Writing of Project

A format, such as given below, can be followed.

(i) **Title of the investigatory project**: Write the title of the project, for example, 'Inheritance pattern of eye colour'.

(ii) **Objectives**: Express as clearly as possible the effect of one variable that the experiment is designed to investigate.

(iii) **Materials needed**: This might be just a list, or a diagram if a particular piece of apparatus was used.

(iv) **Method**: Describe the procedure stepwise including the precautions taken, if any.

(v) **Result**: A suitable chart or table for recording and organising your readings or measurements should be made out before you start the experiment.

(vi) **Analysis and interpretation**: Observation data are factual, and may not be as expected by you.

(vii) **Discussion**: Discuss briefly the implication of your results and suggest extensions of any kind that can be undertaken.

(viii) **Conclusion**: In view of the results obtained and related work done on the topic of the project, write conclusion briefly.

(ix) **References**: Any work related to the project which you have come across through books/articles or any other source should be written as reference, for example: Michael Michalco (2001), *Cracking Creativity*, Berkeley, Ten Speed Press.

This write up is meant to train the students in scientific methods. In other words, it accentuates the spirit of enquiry and investigation in young minds.

The operational aspects of doing a project include choosing a hypothesis or problem to be investigated, collecting data in a designed manner, analysing the data in a scientific way, drawing conclusions which are justified and discussing the results in the light of known knowledge and bringing out its importance. Finally it includes the scientific way of communicating the findings.

While your discovery during the investigatory project may not merit a Nobel Prize it may help you discover something, a fact or relationship that was unknown to you and that was not recorded in any book available to you. Scientists refer to this as an independent discovery. Your investigation will certainly give a sample of the thrill of discovery.

Following are pages on procedural guideline about a few suggestive investigatory project work.

1. Investigating the pH of a water sample

Background information

Monitoring the physico-chemical properties of water is of vital importance. Normal maximum permissible limit of pH for our life and health is 6.5–8.5.

Abnormal levels of pH and their consequences are given below:
pH 3 to 5 is too acidic for most organisms to survive, when the pH of water falls below 4.5 most of the fishes die, leaving only a small number of acid-tolerant insects such as water boatman and whirligig. These insects (beetles) can survive and multiply even at pH 3.5. Similarly, pH>8.5 is too basic for most organisms to survive.

Materials needed

- Universal indicator test paper (broad range, narrow range PH 2–11)
- Water sample

2. Investigating the biochemical (also called biological oxygen demand (BOD)) of a water sample as pollution indicator.

Background information

A dissolved oxygen (DO) test measures the current status of oxygen in a water body. This is a useful starting point.

However, DO content can vary considerably from day-to-day as affected by many factors like temperature, wind velocity, eutrophication, pollution, etc. The unpolluted water is characteristically rich in DO and low in BOD.

Higher the BOD, lower would be DO. Conversely, the polluted water has high values of BOD. Water for drinking should have a BOD less than 1. Typical BOD value for raw sewage run from 200–400 mg of oxygen/litre. The maximum